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Topics . . .

"CASEHARDENED" glass with four and one-half times the strength of ordinary glass has been recently developed. Not only has its strength been appreciably increased, but in the hardening process the grain of the glass is changed so that in breaking it separates into tiny smooth-edged cubes. These cubes cannot do much cutting and they also tend to remain in one plane when the glass cracks, thus keeping it intact in a frame or holder. Applications of the new glass for machinery should be numerous. It may well prove to be especially adaptable on airplanes or automobiles as a part of the supporting structure of the vehicle because of its strength. One shortcoming is that the finished glass cannot be ground or worked once it has undergone the heat treating process.

♦ ♦ ♦

One further step has been taken in making the airplane a vehicle which may finally be kept in the backyard. On display at the National Aviation show in New York City this year was a new convertible autogiro developed by the Kellett Co., Philadelphia, which is capable of driving through its landing wheels on the ground. A similar machine was introduced last year by another company but never reached the stage of production in quantity. Power from the engine is transferred from the propeller to the wheels after landing, the rotor vanes are folded in a straight line, and the roadable airplane can be driven home at a brisk clip.

For the first time in history an airplane with a belt-driven propeller has been successfully flown. The plane was built by students at a Newark, N. J., flying school and utilizes a Terraplane automobile engine which is located in the amphibian fuselage and drives the propeller mounted on the wing above. Five narrow belts are used and after several weeks of flying the drive showed the same efficiency and the same strength as the most modern type of transmission. Advantages claimed for the use of belting are that any sign of wear would show a long time before the danger stage is reached, speed reduction is accomplished quietly and the drive is comparatively inexpensive.

♦ ♦ ♦

Novel use of an elevator to facilitate factory conferences and increase efficiency has been initiated by the president of a shoe manufacturing company in Czechoslovakia. He lamented the time lost in calling together floor managers for short conferences in his office every day so decided that he would come to them. Too, he had noticed that the most efficient work was done by those who worked in the vicinity of his office and it occurred to him that this same efficiency might be developed on each floor of the factory if his office could be easily moved. An elevator, therefore, was constructed on the outside of the building. Desk, telephone, and other office equipment was placed in it and the executive rode merrily up and down as he dictated letters or conducted the day's business. Efficiency in all departments showed a distinct increase as workmen realized that the "big boss" might be hovering near.

♦ ♦ ♦

Casting of stainless steels which has long proved a stumbling block to metallurgists and foundrymen has now been successfully accomplished in a hollow-electrode furnace. Surface continuity, freedom from porosity and piping, and cleanliness were conditions that had to be met to make stainless steel castings practical. The widespread use of stainless steels on machinery in forged and drawn forms will probably be augmented now with castings of basic parts where finish, machinability and corrosion resistance are important considerations. Small articles such as chains, levers and pawls have successfully been cast in 18-8 stainless steel.

♦ ♦ ♦

Automobile manufacturers do not want to be caught with an unacceptable model if they should bring out a rear engined car soon. To make doubly sure that they could quickly change to a conventional type car, one body manufacturer is producing a body that can be adapted to front or rear engine design. If the rear engine idea didn't take, the power unit would be moved up front.

MACHINE DESIGN

X-Ray Safety Devices Overcome Human Fallibility

By Fred Kelly

Associate Editor, Machine Design

SINCE the days of early medical history, doctors have been dependent on engineers to help them meet the exacting requirements of the medical profession. Without instruments and different types of machines the general treatment of disease would be considerably handicapped and surgery would be almost impossible. The tools of the doctor, however, have been comparatively simple until recent years when respiratory and numerous other machines have enabled him to treat maladies that had seemed incurable in previous generations.

In designing the equipment of the doctor, the engineer has been forced to place special emphasis on safety and protective features. Machines which might fail during a crucial operating period or those which because of their construction were unsafe for the mechanically unskilled physician to use might easily do more harm than good.

Perhaps one of the best examples of present day machines used by the medical profession and embodying numerous protective devices is the X-ray generator. Electrical engineers must be credited with its early development, but it is the mechanical designer who has made it a compact, foolproof machine in which the life-saving yet deadly X-ray radiations are completely controlled. From a bulky machine, it is now an attractive appearing one that can be used for patients with ease and convenience.

Safety of operation with lightness and compactness have been adequately built into the Waite and Bartlett therapeutic X-ray machine shown in *Fig.* 1. It was necessary that the designer provide a unit that could be easily moved and adjusted to the patient, and yet successfully insulate all parts from the 200,000 volts on which the machine operates.

The first move to this end was the cooling and in-

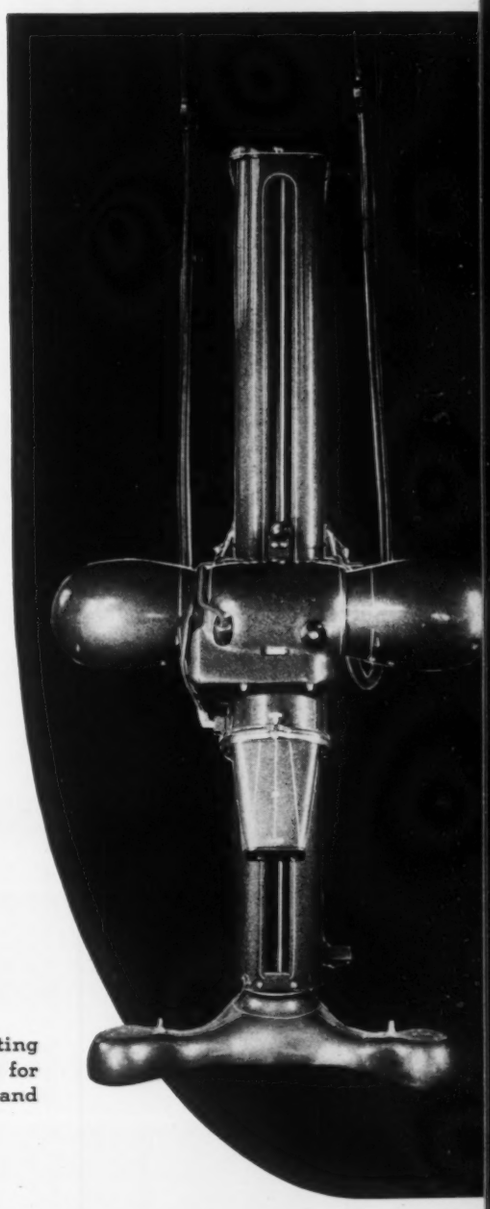


Fig. 1—X-ray generating machine is designed for durability, safety and handling ease

sulating of the X-ray tube. Heat generated in the tube must be quickly dissipated to prolong its life and prevent heating of the entire machine. Previously the tube was air-cooled, necessitating a large air space between it and the outer shield. Not only did this construction make the machine bulky, but the possibility of arcing to the ground was always present.

Oil was chosen as an ideal coolant for the operating conditions of the X-ray tube. It not only prevents corrosive action but makes a shockproof insulation. Water, although having a greater cooling effect, will permit the passage of electricity through it which would defeat the purpose of this safety feature. The oil is circulated by a small gear type pump housed in a water-cooled tank and piped by flexible tubes into the shockproof head, *Fig.* 2, and around the X-ray tube. *Fig.* 4 shows the motor, pump, water-cooling coils and automatic safety controls unassembled and *Fig.* 5 illustrates the unit intact.

The pump *A* in *Fig.* 4 is submerged in the oil tank, which may be placed for convenience some distance from the X-ray machine, and pumps the oil under 40 pounds per square inch pressure through flexible tubes to the shockproof head. Cool incoming oil is led through a small brass pipe seen at *A, Fig.* 3, to the very base of the hot X-ray target *B,* where it is discharged into a restricted section insuring rapid movement with heat dissipation. When the oil is started circulating before the target has warmed up its increased viscosity will raise the oil pressure considerably. To prevent the pressure doing damage to the machine a by-pass valve *B, Fig.* 4, has been placed in the outlet manifold of the pump.

Electrical controls of the motor are wired so that when the main operating switch on the control board, *Fig.* 6, is turned on it immediately starts to run. A bellows diaphragm, *C, Fig.* 4, is actuated by the oil pressure and controls a set of contacts which prevent electricity being applied to the tube until a certain oil pressure is reached. This precaution prevents exposure of the tube without a generous supply of circulating oil.

Oil Temperature Regulates Exposure

A second safety device is mounted on the return oil manifold and is therefore affected by the hot oil returning from the tube. A thermostat *D, Fig.* 4, will open electrical contacts and stop the exposure if the temperature of the returning oil exceeds 135 degrees Fahr. A magnetic water valve *E* is controlled by the main switch on the control board, but at the same time it is connected in series with a thermal control mounted in the tank of cooling oil. For this reason water will flow only when the oil temperature reaches about 90 degrees Fahr. and stop when it drops to 80 degrees Fahr. A 150-foot coil of copper tubing *F* is immersed in the oil through which water circulates at city tap pressure.

Draining of the oil from the tube chamber when replacement of a tube is necessary is facilitated by a switch mounted on the cooling unit which can be turned to reverse the motor and open an air vent in the tank which allows the oil to be pumped from the head back into the cooling unit. In filling the tube chamber with oil the switch is turned to a position marked "fill"

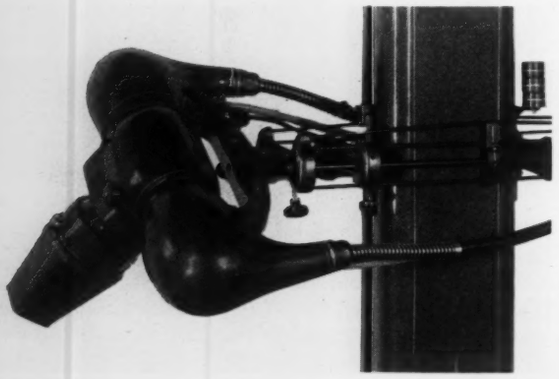


Fig. 2—Oil tubes and high voltage cables do not interfere with adjustability of X-ray head

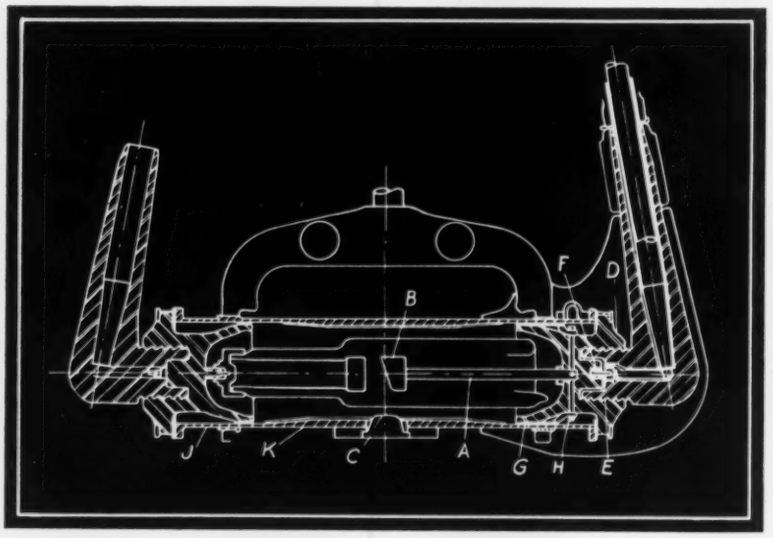


Fig. 3—Cross section of X-ray head shows relation of tube, oil chamber and high voltage cables

which runs the motor in conventional direction but leaves open the air vent until the head is full of oil. The switch is then turned to the position in which all air vents are closed for operation.

To minimize the possibility of a patient being exposed to the tube radiations before a definite time interval has been selected, a motor-driven lead shutter has been installed over the aperture of the X-ray. This mechanism also allows the shutter to be controlled from the control board which is usually located in an adjoining room to that in which treatments are given. The shutter is designed to exclude all radiations of the tube and utilizes a 3/16 inch lead plate which slides in suitable grooves. A small induction motor operates a crank arm through a series of gears to open and close the shutter. Ordinarily it is closed during the voltage build-up period of the tube so that the patient will not be subjected to undetermined radiations. Limit switches are provided on the control board so that the shutter may be held open or closed. A neon lamp connected in the shutter circuit lights when the shutter is open.

Window Withstands Beams

A cup-shaped transparent window, *C, Fig.* 3, made from a substance which does not disintegrate from the X-ray beam, has been designed to fit in the aperture of the head. By placing the window so that the cupped part faces the tube the oil film is only about 3/16 inch thick at this point. Absorption of the rays would result if the oil film thickness were too great.

Filter plates are mounted on a movable drum which extends around the head and can be adjusted to place any one of the five different filter combinations before the aperture. The plates are combinations of aluminum, copper and tin and serve to modify the effective wave length of the X-ray beam. Each setting of the drum is made with a hand-operated knob and makes contact with an indicator switch on the control board in each position. Unless the switch on the control board is set to correspond with the filter setting it is impossible to make an exposure. The lighting of another neon lamp connected in the filter circuit indicates the correct adjustment.

Human Element Is Precluded

Every effort has been made in the design of the X-ray machine to exclude the human element in its operation. The smallest details are handled by mechanical or electrical devices which obviate any chance of allowing the powerful radiations to harm either the machine or the patient. Mounted at the top of the control board is still another safety device which insures that exposures will last only a period of time as designated by the operator. It is essentially an electric timer which makes use of a self-starting synchronous motor geared to provide the correct time ratio and operate a normally closed switch. A hand is set for the desired length of exposure and when it reaches zero the switch opens the circuit, thereby stopping the exposure.

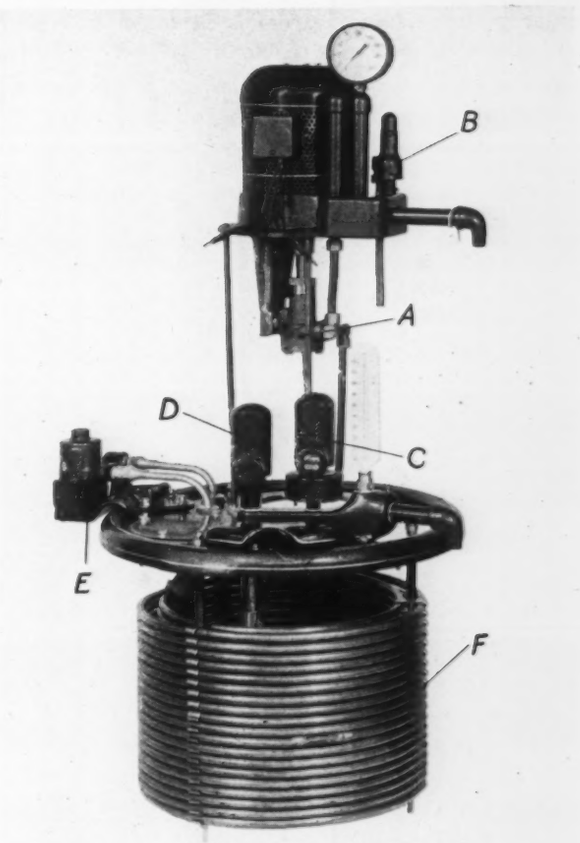


Fig. 4—Watercooled coils keep oil temperature under 135 degrees Fahr.

Fig. 5—Safety devices on cooling unit regulate oil and water flow

Besides voltmeters and ammeters for reading the amount of power on the tube, an ionization chamber is provided which gives the intensity of radiation as the beam emerges from the aperture. Built in front of

the automatic shutter, it consists of a number of thin copper plates insulated from each other. These are connected to a meter on the control board.

Numerous materials are employed in the apparatus for insulation against the high voltage and to "kill" the penetrating radiations of the electronic tube. At each end of the head are the insulating terminals *D* of the high voltage cables. Made of a special plastic including asbestos and shellac, it has a high dielectric strength and will successfully prevent seepage of the voltage to the metal parts of the head.

Designers of the machine utilized a novel method of insulation at the point where the high tension cable enters the insulator. A bakelite sleeve was machined

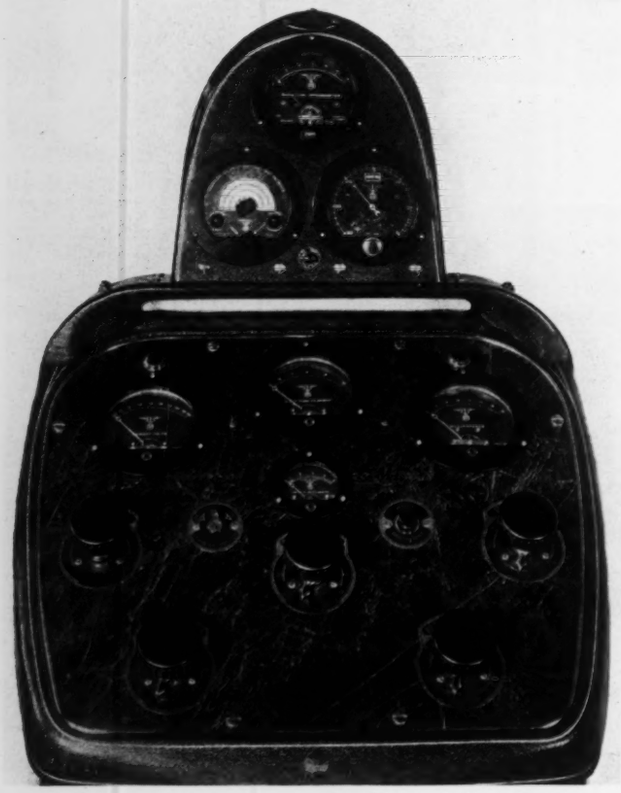


Fig. 6—Switches and timing devices on control board permit remote operation of X-ray machine

to fit the taper of the inside of the insulator and then cemented to the cable. The cable itself is protected and insulated with a special synthetic rubber which withstands the corona set up by the high voltage and does not deteriorate from the heat.

In order to permit the movement of the head without undue twisting of the cables the terminal insulators are made in two parts so that they may turn. A screw thread *E* is used for the joint which has a sufficiently great electrical leakage distance. Between the connections in the insulating terminals a special spring *F* is provided which withstands any corrosive action. Corona formed by the voltage at this point will cause the formation of nitrous oxide which would combine to form an acid inimical to ordinary metals. Between the brass tubing of the case and the anode insulator is a leather seal *G* which keeps the oil from leaking out of the head chamber. Studs and nuts *H* which fasten the base of the insulator to the head are made of hard rubber.

Inside of the brass case *J* of the head is a heavy lead sleeve *K* ¼-inch thick which extends almost the entire length of the oil chamber. Penetration of the radiations from the tube in other directions than through the aperture is thus prevented.

Aluminum Finds Wide Use

Aluminum finds a wide use in the construction of the machine as a weight saver. Aluminum castings cover the insulating terminals at each end of the head and also are used for the base of the machine. The shutter switch spring which receives severe treatment is made of beryllium copper. Experiments with many metals proved that this material would best allow continual flexing of the spring without fatigue.

Thus by the keen application of suitable materials and intricate mechanical devices, the engineer has found plenty of opportunity to apply his knowledge in designing a machine that is not only compact and efficient but safe and simple to operate.

Rear-Engined Auto Is Trend

SETTING the automobile engine crosswise to the chassis and under the rear seat appears to be the final solution of locating the power plant in the auto of tomorrow. This positioning makes practically 100 per cent floor space available for seating capacity and aisle space, while at the same time rendering the power unit more easily accessible as compared to any other engine location.

With the engine crosswise in the rear, rubber-mounted and suitably insulated, the minimum amount of noise and vibration penetrates to the passenger compartment.

Many schemes for the arrangement of the engine and gear box in relation to the driving axle have been put forth, but on account of unnecessary complications and large space requirements they were either discontinued after small quantities were manufactured or did not pass the experimental stage. When the engine crankshaft is parallel with the axle drive shafts, the transmission shafts must be at right angles to the engine crankshaft and axle shafts. Indirect drive transmissions are employed by two coach manufacturers while direct drive transmissions are used by one.—Abstracted from a paper presented last month at the annual meeting of the Society of Automotive Engineers in Detroit by C. D. Peterson, Spicer Manufacturing Corp.

SCANNING THE FIELD FOR IDEAS

BRAKE mechanisms for heavy trucks and busses not only must be quick-acting and dependable, but also they must be able to radiate quickly the large volume of heat into which the power stored up in the moving vehicle is converted as the brake retards it.

The diagram, *Fig.* 1, depicts an interesting emergency braking system developed by the American Cable Co., Inc. for application to standard transmissions. The braking effect is attained by clamping a cored metal disk between a pair of segmental shoes faced with friction material. These shoes are pivoted at their back centers to levers which are hung on pins at the top.

These levers are drawn together at the bottom, against the pressure of a coiled spring, by a third lever which—simultaneously—acts directly on one of the shoe levers and through a drawbar on the other. This simple and powerful linkage, as shown by the diagram, gives balanced action without end thrust, at the same time seating the shoes parallel on the disk.

The most important feature of this design is the effective self-cooling of the disk by the large volume of air which is caused to flow through it from bore to periphery by the "centrifugal blower" effect of the cored radial passages. For extra heavy duty the system is doubled, a duplicate of the mechanism just described being mounted around the opposite edge of the disk. Both units are operated in unison by a cross shaft.

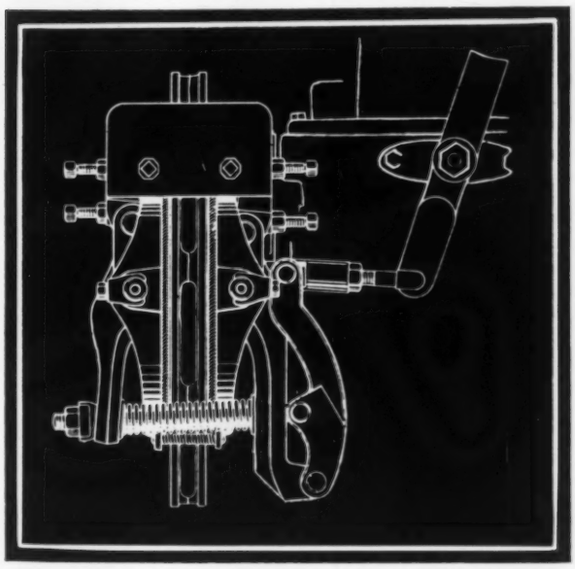


Fig. 1—Centrifugal blower effect, inherent in cored disk, cools this heavy duty brake

Motor Floats on Springs

AN ORDINARY induction motor has pulsating torque, this being rotational vibration with frequency of 120 cycles in the case of a 60 cycle motor. While correct design from the magnetic and mechanical standpoint, together with dynamic balancing, eliminates other forms of vibration, it does not eliminate this torque pulsation.

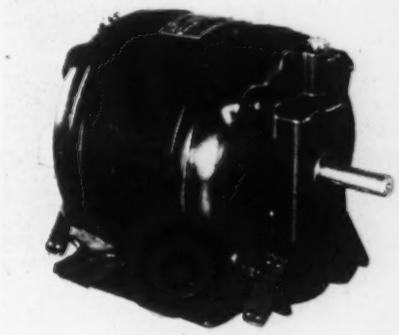


Fig. 2—Vibration of pulsating torque is ironed out by resilient base

As a secondary design feature to absorb this pulsation, the Holtzer-Cabot Electric Co. has developed the resilient motor base depicted in *Fig.* 2 This consists of a separate frame to which the motor itself is attached at the four corners by flat laminated steel springs. These springs are set radial to the armature shaft and are so

proportioned that while the center of the shaft remains quite accurately and permanently in position, the motor as a whole can vibrate rotationally about this axis. In other words, it is as though the motor were mounted in a cradle with rockers running crosswise. The effect is that the motor can vibrate and absorb the torque pulsation without transmitting it to the subbase, thus eliminating noise.

Various modifications of this construction are also employed, depending upon whether the motor is floor mounted (as in the cut), wall mounted, ceiling mounted or located with shaft vertical. For instance, the motor may be suspended at one end by four springs extending outward in four directions all in the same plane perpendicular to the shaft, this being in effect a resilient flange-mounting. Again, the motor may be suspended by a band around its frame, this assembly being supported by three or more flat springs extending radially outward, thereby allowing the motor to roll slightly in its mounting.

Tires Float Vehicle

NOT so long ago automotive vehicles would not operate under such difficult conditions as would those drawn by animals, but today motor driven vehicles are built which are able to cope with conditions under which draft animals would be helpless. For example, consider the so-called "marsh buggy" developed by research engineers of the Gulf Oil Corp.

This remarkable vehicle, shown operating in deep water in *Fig.* 3, has been designed to transport geophysical crews and their equipment for oil prospecting in what formerly were almost impenetrable swamps of Louisiana. It operates on dry land up to 35 miles per hour, in waist-deep mire up to 10 or 12 miles per hour and in deep water up to 6 knots, its versatility depending to a large degree upon its special four-ply pneumatic tires. Developed by Goodyear, these are the largest ever molded for commercial purposes. They

Fig. 3—Travel over land, swamps or water is made easy by this "marsh buggy" with 10-foot pneumatic tires

are 10 feet high, nearly 3 feet wide and are mounted on 66-inch rims. Although the 22½-foot vehicle weighs 7500 pounds and will carry a 1000-pound load, the tires carry only 6 pounds air pressure and support it in deep water with immersion of only 2 feet, which gives clearance of 1 foot, 9 inches between the water and the bottom of the chassis. Ordinary tire leaks are taken care of by a compressor which will feed quantities of air into the tubes while the wheels are revolving, thus permitting return to the base for repairs. In case of complete deflation even of all four tires, the airtight aluminum drum wheels will float the vehicle safely.

The power plant is a Ford V-8 automobile engine located behind the driver's seat with its transmission

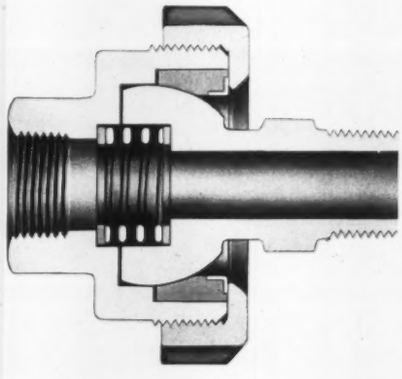


Fig. 4—Swivel pipe joint withstands hot steam and cold water

coupled in series with a McCormick-Deering tractor gearbox. This combination gives ten speeds forward and six reverse. The tractor transmission is fastened rigidly to the frame, the rear wheels being mounted at the ends of its extended axles. There are no springs, the big tires making them unnecessary. The front wheels receive power from drums connected by chains to sprockets on the rear axles, special couplings permitting front wheel steering similar to that of an automobile. The tractor transmission has brakes which will lock either the right or left wheels—thus when operating in deep water the machine can be driven by all four wheels or by the two on either side which allows quick turning.

Swivel for Brass Piping

STEAM-HEATED presses such as are used in the plastics molding and rubber industries require swivel joints in the piping connections to the moveable platens. Subjected as they are in many cases both to pressure and suction, to vibration, deflection other than swiveling and to alternating "shots" of hot steam and cold water, these joints have presented a real problem in design.

In *Fig.* 4 is shown in section a type of swivel joint

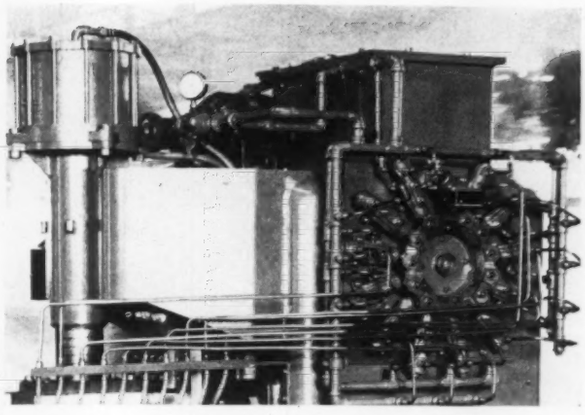


Fig. 5—Control for automatic welder has the appearance of a radial aircraft engine

which has been developed by the Barco Mfg. Co. It will be noted that not only are 360 degrees of rotation of ball member possible but also by giving this member clearance at the bottom of the cup some degree of lateral rocking is made possible.

Control Is Radial

ADAPTABILITY of hydraulic control to automatic operation of industrial machinery is strikingly demonstrated in the Thomson-Gibb electric welder of which the principal features are apparent in *Fig.* 5.

This machine, called the Multi-Spotmatic, has four transformers and a series of hydraulic plungers actuated in rotation to make a number of spot welds. An indexing work-holding device makes possible the welding of rows of spots at predetermined positions on the work. Probably its most interesting feature is the rotary control valve mechanism. This is mounted on the frame and looks very much like a radial aircraft engine. It controls pressure and duration of current flow for each individual weld, at the same time compensating for thickness variations in the metal being welded.

The control is actuated by a fractional horsepower motor which can be arranged to drive either through change gears or through a variable speed reduction unit. The output shaft extends through the frame of the machine and keyed to its outer end are two operating disks. The inner disk (not visible in the illustration) carries a single dog which actuates in succession the radial piston valves deployed around the centerline. Each valve is connected to a small hydraulic cylinder which in turn actuates a single electrode.

The outer disk, which has twelve cam lobes on its periphery, revolves as a unit with the inner disk. Its lobes operate a limit or relay switch which in turn operates a contactor or timing device to regulate the primary current of the welding transformer. It will be noted that the cam lobes are of double construction, making them adjustable to give either a long or short period of current dwell. There is a clutch in the driving mechanism which causes the cam disks to stop at the end of every revolution. The cam shaft can be made to revolve from four or five revolutions per minute up to fifty or sixty, this depending on the type of work. There is a clutch in the driving mechanism which causes the cam disk to stop at the end of every full revolution.

Keeps Cable Coiled

TRANSMISSION of electric power to a unit drive motor on a member which travels in relation to the rest of a machine often is a problem. This is especially true when a considerable amount of power is involved and the moving member has a wide range of travel.

Such a problem in a new line of self-contained cylindrical grinding machines has been met in an ingenious way by engineers of Cincinnati Grinders Inc. The nature of problem and solution is clear in *Fig.* 6.

Single braid rubber-covered flexible cables are threaded through the three-legged bracket of the reel mounting, thence through the hollow fixed shaft on which the drum rotates. The free ends of these cables are fitted with soldering lugs by which they are connected to the main power feed cable of the machine, while the other ends pass through a slot in the drum shaft to bronze slip rings mounted on and separated by fiber bushings and spacers.

Bearing against these slip rings are spring brushes carried on studs inside the drum. Each of these brushes in turn is connected with a lead of the motor cable which is threaded through a hole in the drum on which it is wound.

Within the drum is a strong torsion spring, one end of which is anchored to the drum and the other to the mounting bracket. As the work carriage moves away from the reel assembly, the cable is kept taut, being unwound from the drum against the tension of the spring. The resulting winding up of the spring causes the drum to rewind the cable when the carriage returns.

Fig. 6 — While carriage of this cylindrical grinder travels back and forth, feed cable to the work revolving motor is alternately paid out and reeled in by spring-driven drum

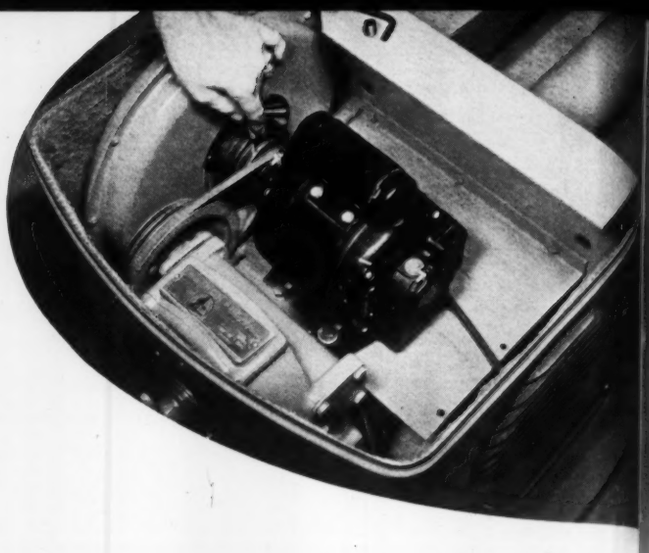


Fig. 1—A hollow set screw can be used at the bottom of the groove in a V-belt pulley, as in the drive of the Iron Fireman stoker

Traditional Screw Specifications No

VITAL details in a machine — regardless of its size or its complexity — are not necessarily the parts which have been designed especially for it. They are in practically every case those inconspicuous standard items in such common use that they are all too frequently "taken for granted" or at least specified by designers with very little thought as to their importance. Of these so-called "minor details", set screws and cap screws are the most common, yet the failure of a single one frequently means the breakdown of an entire machine.

Set screws of "blind" or "safety" type originally were slotted for screw driver application. They were designed to replace in exposed revolving and other moving members the ordinary set screw with square protruding head. While the square head screws do have an entirely legitimate role in machine construction, their promiscuous use in rapidly moving parts was for at least a hundred years a common cause of injury to operators, to machines and to work. It is surprising that engineers and legislators were so slow in acting to outlaw this hazard.

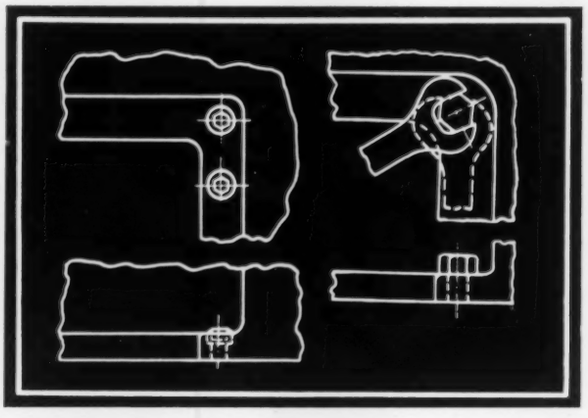


Fig. 3—Because wrench works internally, clearance and overhang can be cut down by using hollow screws

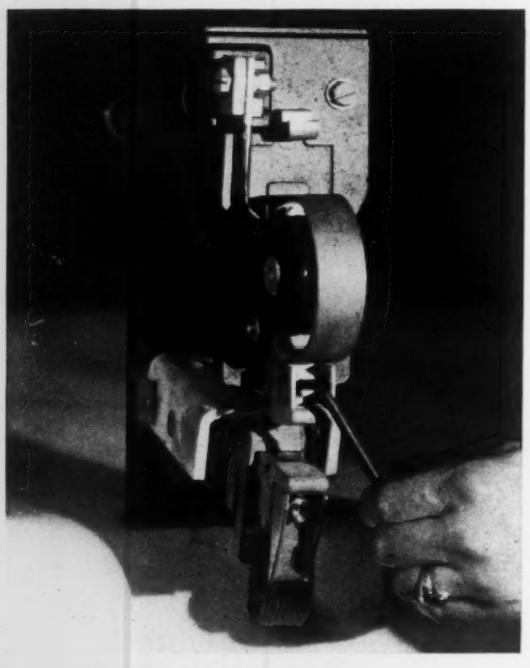


Fig. 2—Space is saved holding insured by hollow screws in Westinghouse type SM contactor

The slotted "safety" or "blind" set screw was the first step, and a very definite step in the right direction. However, practical limits to the degree to which these screws can be tightened with a screw driver have generally limited them to the lighter services, where they still are widely and successfully employed. Not until the advent of the "socket" or "hollow" type could set screws with protruding heads definitely be eliminated from all the danger points in heavier types of machinery.

Having won deserved recognition in the set screw field, the "socket idea" began to spread and it rap-

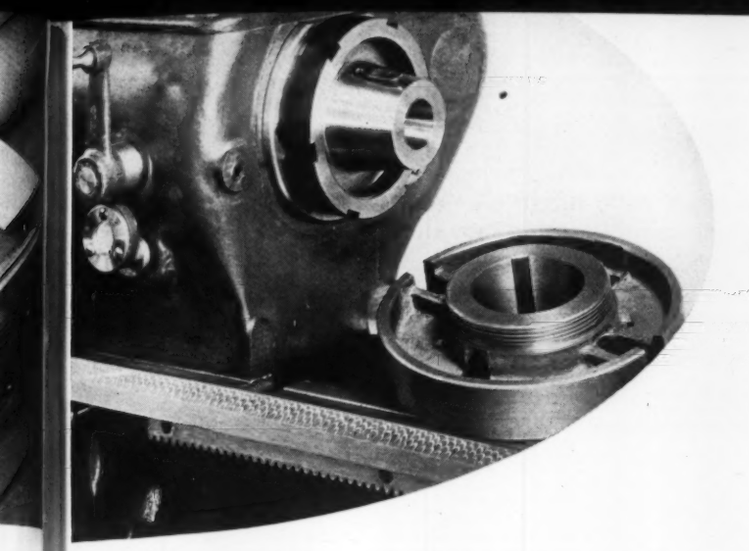


Fig. 4—Hollow screws in this lathe allow parts to operate in close proximity, give clean lines and eliminate skinned knuckles

Longer Apply

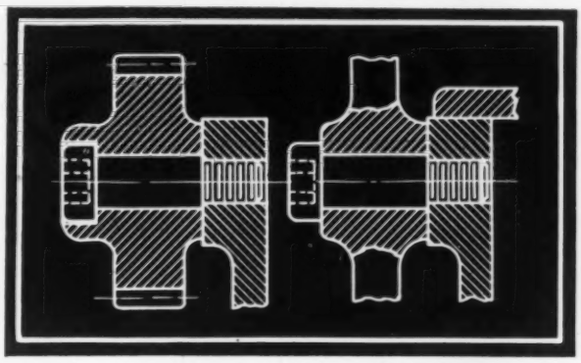


Fig. 5—Standard hollow shoulder screws often can be used instead of special studs, at less cost

idly is becoming of major importance in the realm of cap and shoulder screws also. While safety is one incentive toward adoption of hollow cap and shoulder screws, their use is dictated by other design considerations, of which appearance is by no means the least important.

Scientifically heat treated hollow screws of chrome nickel, chrome molybdenum and other special alloy steels, now stocked in a wide variety of standard shapes, sizes and threads, can be set down as tightly as screws of their size should be under any ordinary conditions. Regardless of type of socket, their standard wrenches have been designed and treated to withstand the torsion required for maximum *safe* setting.

Recently approved National standards for sockets have brought about interchangeability of wrenches, even to the extent that it now is possible to use hex wrenches in corresponding sizes of screws with multiple spline sockets. It also is possible to use a piece of ordinary hex stock or even a screw driver in either hex or the splined sockets These practices are no more to be recommended, however, than is that of using a pipe wrench on standard nuts, bolts and cap screws.

Applications of hollow set screws are better understood by designers than are those of hollow cap screws. Safety is of course the primary consideration. In overhauling previous designs they should be checked carefully to see that hollow set screws are specified at every point where a protruding head introduces the slightest element of danger. For the sake of standardization and good appearance there are some instances where hollow screws properly can be specified throughout a mechanism.

The foregoing statement is not intended to condemn all uses either of square head or slotted screws. They definitely have their place. This is true particularly of the extra strong heat treated square head screws now available. These play an important part in design — particularly of heavy equipment such as rolling mills, forging machinery, locomotives, mining machinery and road machinery. Manufacturers who make both hollow and square head screws recommend the square head type at points where protruding heads present no hazard, where maximum pressure must be exerted. They point out that they will give about three times the gripping power of a hol-

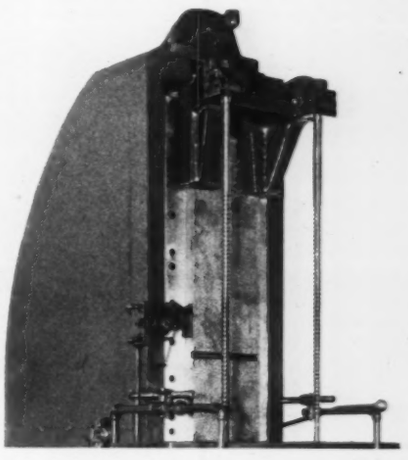


Fig. 6—On this broaching machine, hollow screws are placed close to walls and in intimate grouping

low head screw of the same diameter, one of the better quality standard square head screws of ⅝-inch diameter and 2½ inches long being capable of exerting gripping power in excess of 25 tons. An example of a place where this gripping power can be used to advantage is in the tool blocks of heavy duty machine tools.

In working out a new design it should be borne in mind that hollow screws can readily be inserted into and tightened up in what ordinarily would be inaccessible places. They can be placed on the end of their wrench and so inserted into deep recesses far beyond the reach of the fingers. This characteristic is especially important in smaller mechanisms such as instruments and electrical apparatus. An example is presented in *Fig.* 1, by the hollow set screw sunk into the bottom of a groove of a V-belt pulley in the drive mechanism of an Iron Fireman stoker. Another is the Westinghouse type SM contactor in *Fig.* 2, where special hex head screws with sockets are set down firmly in very restricted spaces.

Appreciation of the advantages of hollow cap screws seems to have originated among designers of jigs, fixtures, dies and tools. Designers of products in mass production have been rather slow to grasp the possibilities of these screws and so there are still numerous applications which can advantageously be made. The recent trend toward styling of industrial designs — often loosely referred to as "streamlining" —is giving great impetus to more general use of hollow screws. When countersunk their flush setting is a major asset to the smooth surfaces which are so important in these modern designs. This point is illustrated by *Figs.* 4 and 6. There no longer is any excuse for having the smooth sweep of a surface broken by unsightly screw heads, thereby spoiling continuity of a design.

Fig. 7—Examples of the broadening applications of the "socket idea", at the left a purging valve used in electric refrigerators and at the right a pipe plug

The latest engineering handbooks will be of considerable help by giving useful data on hollow screws. Recent publications by manufacturers of the screws will also be found extremely useful, and have been drawn upon heavily in the preparation of this article. Therefore a word of hearty appreciation is due Allen Mfg. Co., the Bristol Co., Holo-Krome Screw Corp., Macit Parts Co., and Standard Pressed Steel Co. When it comes to applying the hollow screws to full advantage, however, that is the time for the designer to give free

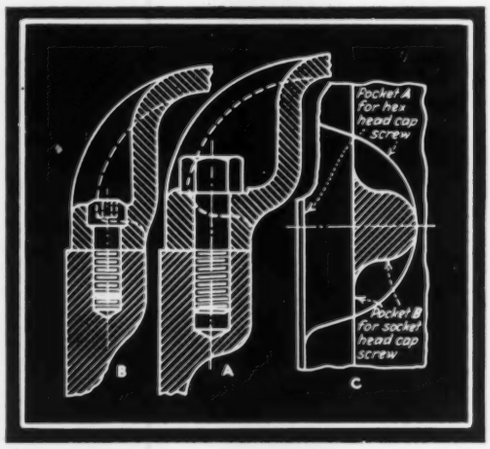


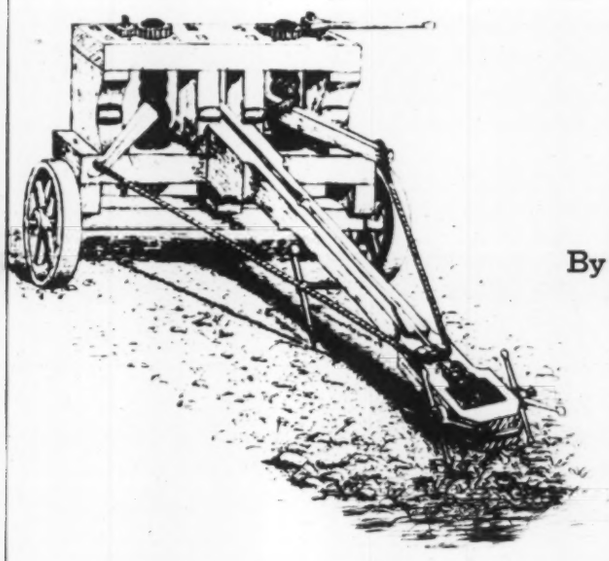
Fig. 8—When designing for hollow screws, take advantage of their space economy

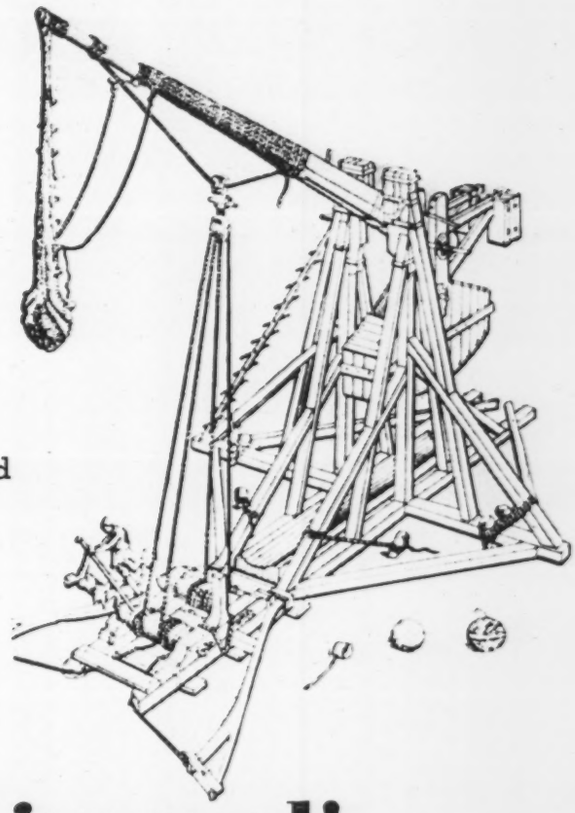
sway to his own ingenuity and common sense. While he will get ideas from examining other recent designs, such as those pictured in this article, the field is so open that mere copying will seriously limit the possibilities.

One very important point to remember when designing for the use of hollow cap screws is that the generous clearances demanded by ordinary wrenches no longer have to be allowed. This makes it possible very materially to reduce size of pockets, flanges, overhangs and bosses, as is brought out clearly by the diagrams *Figs.* 3 and 8. For the same reason, the hollow screws can be grouped closely when strength demands it, as the heads will not interfere with each other. This is brought out in the view of the brackets and broach clamps at the top of *Fig.* 6.

By setting the screw heads flush with or slightly below the surface, parts of a machine frequently can be given much closer clearance than previously had been the case, thereby making for compactness by reducing overhang. This is true on the lathe head, *Fig.* 4. It will be noted that the chuck clamping nut lies flush with a ring held to the headstock by hollow cap screws. A similar end has been attained on the broaching machine in *Fig.* 6, the gibs being held to the frame by flush-set hollow cap screws which avoid any danger of interference with the slides.

Ingenuity of the ancients is proved by the Roman Ballista —below—a spring-operated field gun. Also by the Trebuchet—right—a huge mechanical sling of the Middle Ages





By Guy Hubbard

Design Is Universal!

Courtesy, Wallace Barnes Co.

IT'S a peculiar fact that the ancients had a broader conception of the meaning of the word "Machine" than does the average person living in the present so-called "Machine Age." A dictionary definition of this word "Machine" is, "Any combination of mechanism for utilizing or applying power." While the old-time machines were simple affairs and the amount of power involved was small, they were more generally recognized as machines than are their numerous counterparts today.

For some reason the average person now thinks of a machine primarily as something large and powerful—a steam shovel, a punch press or a heavy machine tool for instance. When an artist seeks to embody in a picture the spirit of the machine, it is more than likely to materialize as something huge, hot, smoky, awe-inspiring, dangerous and probably badly designed. It would be much more in keeping with modern engineering and with the true spirit of this machine age if the artist could dramatize the accuracy, dependability and efficiency of a watch, the clean, silent power of an electric motor or the ingenuity involved in some mechanical office appliance. The drawback is that even though the average person is surrounded and served by—and his very life regulated by—such machines as have just been mentioned, he does not recognize them as machines and so does not realize how complete is his dependence upon the machine designer.

Specialization Gone Wrong

Lack of realization of the broad scope of the machinery field is by no means confined to the layman. All too many engineers and designers—especially the older ones—are afflicted by it and thus are seriously handicapped. The most dangerous misunderstanding of the meaning of specialization is that which prompts a mechanical engineer or machine designer to say, "I am a specialist in the 'A' field, therefore new developments in the 'X', 'Y' and 'Z' fields are of ab-

solutely no interest or value to me!" That is the beginning of the end for him and perhaps for the company dependent upon his work.

Equally short sighted is the designer who fails to pay attention to new and improved materials—far removed though they may seem at the moment of affecting the work on which he is engaged. In these days when research laboratories of large companies are so actively engaged in developing new engineering materials, and the marketing divisions are so aggressive in promoting their use, widespread adoption is swift, and sweeping in effect.

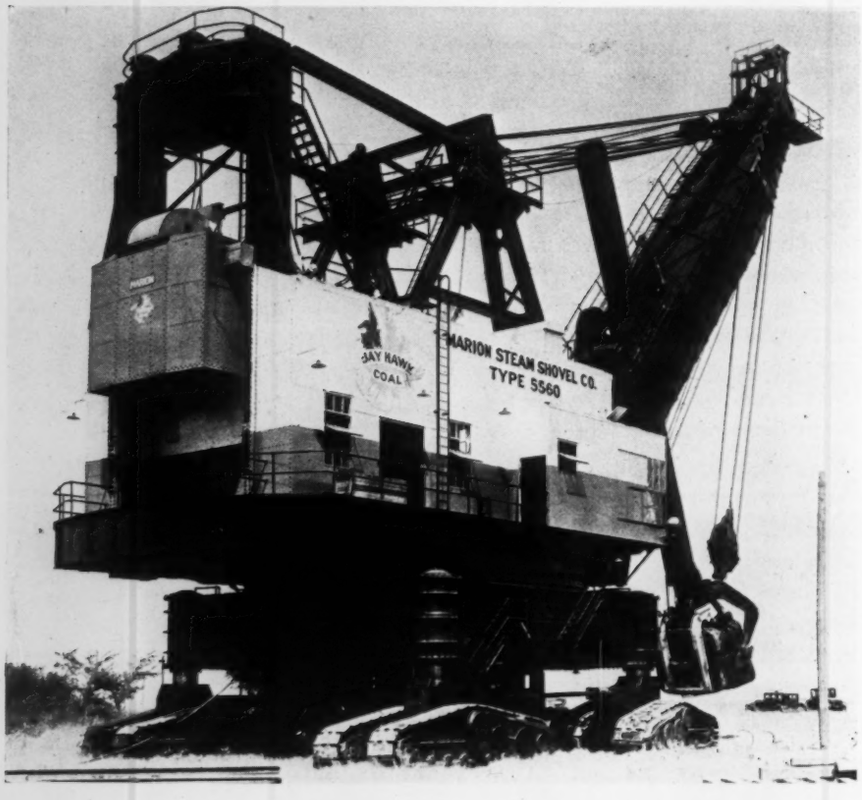
Ideas Are Interchangeable

Interchangeability of ideas is just as important in the machine design field as is interchangeability of parts in the machine building field. Designers who realize it are ever on the alert to grasp and utilize ideas, just as James Watt grasped and utilized the force which lifted the cover of a tea kettle. It is the keen engineer today who—though he may be a specialist on tabulating machines—hears or reads about a meat slicing machine and gets an idea for the more effective utilization of materials in his design. Equally smart is he who is a specialist on diesel engines and develops a better valve spring because he has read of an improvement in hair springs for wrist watches. Years ago a smart designer observed a clock movement and derived therefrom the geneva indexing mechanism which is widely used in automatic machinery of so-called station-to-station type.

It may seem contradictory to say that in spite of increasing specialization design is more than ever before universal, but nevertheless it is true. If you doubt it, consider the design of a streamlined bullet, a streamlined automobile, a streamlined train and a Zeppelin. The designer who wants to prepare today for what may happen in his special field next week or next year, will be able to do so if he will observe carefully the significant developments in design fields other than his own. But first he must realize that he is a machine designer, regardless of the type of machine he is designing, before he can fully appreciate and profit by the fact that "Design Is Universal!"

Courtesy, New Jersey Zinc Co.

Small and stylish—but nonetheless a machine—an electric mixer is typical of mechanization in modern life



Regardless of its size, this huge excavating machine may have design principles in common with an electric mixer as well as with a Trebuchet

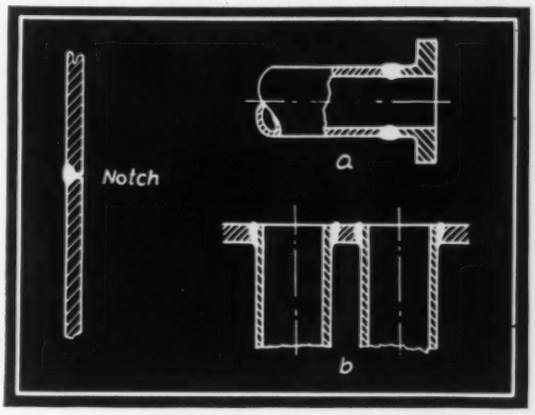


Fig. 1—Improper preparation of material results in notched weld shown at left. Methods of welding difficult sections are illustrated at right

Welding Practices Need More Rigid Control

By Harold F. Shepherd

STANDARDIZATION of welding practice is desirable from the standpoint of the designer, the draftsman and the welding man in the shop. At present almost every company and shop has a different method of specifying parts and sections to be welded. Mr. Shepherd, who is associated with the diesel engine division of the American Locomotive Co., analyzes in this article the points that need control and a method of obtaining it

ELECTRIC welding design, though it has progressed unbelievably from the stage in which one found it a few years ago, is still in a distinctly "ungoverned" category. Various codes set the standards for welding and materials of pressure vessels and structural work, but except for these conventional fields arc welding has a free hand. There are special cases where designing and welding engineers have collaborated with government departments or underwriters, but ordinarily there is little semblance of order in this branch of design. With greater undertakings being launched every day the need for definite welding practice becomes acute. At present the man who claims that he has made a design for welding only too often finds that he has made a drawing for something he wants welded.

Due to the intricate nature of machine housings in particular the successful designer of welded machines

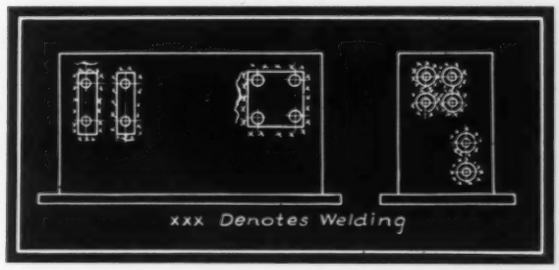


Fig. 2—Several circular welded pads, right, do not stress metal as much as large rectangular ones, left

is obliged to go much farther into manufacturing considerations than is necessary when castings are used. It is true that the foundry has its requirements but the processes of molding are by no means so exacting as those of fabrication by welding.

The considerations involved in a practical design might be tabulated as follows:

1. Accessibility for welding
   (a) Possibility of positioning parts for downward flat welding.
   (b) Room for making the best kind of weld for the service.
2. Shrinkage
   (a) Amount of shrinkage.
   (b) Freedom for practically unhindered shrinkage.
   (c) Cumulative shrinkage.
   (d) Possibility of compensating for shrinkage by flexing parts before welding.
   (e) Effects of stress relieving.
3. Materials
   (a) Weldability of materials.
   (b) Relative strength of joint or fusion zone and base material.
   (c) Suitable heavily coated rods.
   (d) Material and qualification tests.
4. Drawings

(a) Sub-assemblies.
(b) General assemblies.

Some of these matters may conflict with each other or with the functions of the part. In such cases the welder is obliged to use special knowledge and skill to attain the desired end or he may be obliged to experiment. In fact some experimental work in the welding department prior to final acceptance of a design is almost always advisable. However, the designer can and should assume much of the responsibility for the practicability of the design, as the following discussion will show.

ACCESSIBILITY. No matter how pleasing the design is in other respects, incomplete accessibility for welding may condemn it. This, of course, is true only of the main stress carriers. In a box structure the designer should construct it in such a manner that major stresses are carried to members which, at least during fabrication, are accessible for downward welding.

Overhead Welds Inferior to Others

Vertical or overhead welding is done with small rods and low current since the metal must stick as soon as it is applied. Such welds are always inferior to the well-fused and puddled downward ones.

No important butt weld should be executed from one side only in tension members. Whether backing strips or U-joints are used it is always possible that the notched condition, at left in *Fig.* 1, exists. The designer should be certain that wherever possible there is clearance for welding from both sides. The procedure required is to weld one side, turn over, chip out, and complete the weld from the side opposite the first weld. It is of utmost importance to use through-welds whereever possible, to avoid stress concentrations.

Fixtures, in some cases with many articulated parts, are used to position work but the product design should be such that a considerable portion of the job is done in each setting. Frequent manipulation and the necessity for many different planes of welding adds much to the cost of shop equipment and of welding.

As an example, one of thousands of such problems is a circumferential weld on a tubular member or vessel which is made while rolling the cylinder about its common axis, the operator working on top. A tube may be joined to a flanged or machined plate in the same way as in *Fig.* 1*a,* but when several tubes are to be joined to the same plate, as for a cylinder block, manipulation of the assembly becomes difficult if not impossible. Perhaps the only simple alternative is the method shown in *Fig.* 1*b.* As this weld is in shear, welding from one side should be satisfactory.

SHRINKAGE. The amount of shrinkage is a matter of experiment for each structure. Some larger machine housings show additive shrinkages exceeding one inch. Naturally this must be allowed for in cutting the steel or the job will not machine to dimensions. Table I was compiled from data collected from a number of jobs and although not quite consistent it at least shows the necessity of considering each weld as a potent stress producer.

Particularly when alloy or the higher carbon steels are used, shrinkage must be practically unrestrained at the stress welds. Cumulative shrinkages as when large pads are welded to restrained and stressed plate structures cause many disasters. *Fig.* 2, left, shows an elevation of a box frame to which pads had been welded. These welds failed in a characteristic manner as shown by the wavy lines. The best technique for this design requires that bosses cut from bar stock be substituted for pads as in *Fig.* 2, right.

With the object of diminishing the effect of locked in stresses due to welding it is always best to weld no more than is absolutely necessary. To this end it is desirable to form plate rather than weld it if the operation can be performed economically. The partitioned assembly *Fig.* 3*a* is quite impracticable when welded as shown. If V or J-joint stress welds are required, the shrinkage of the structure parallel to the partition will be on the average about 1/16-inch per weld or a total of ⅛-inch. This would be resisted by the sheet at the back—most likely causing rupture of the weld during or after welding or buckling of the back. *Fig.* 3*b* is a solution when the partitions are close, for the following reason. Let us assume that one partition is welded in first. The shrinkage reduces the dimension x about ⅛-inch. To insert the adjacent partition the side plates must be jacked apart at the new weld by the

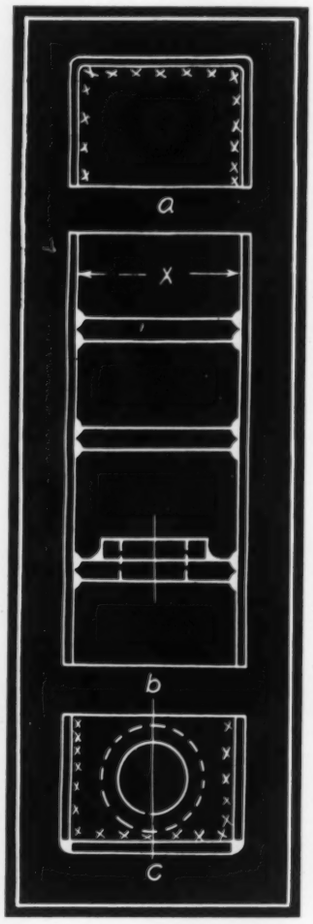


Fig. 3 — Shrinkage must be carefully considered when welding a partitioned assembly

amount of the shrinkage. This is repeated as each deck is welded in. A little preliminary calculation during design will aid judgment in cases like this and in some instances the designer may decide to use filleted T-welds for their lesser shrinkage in place of the superior through-welds.

Designers are prone to put too much faith in stress relieving as a cure-all. Residual stresses always remain since the metal still has a very considerable tensile strength at the allowable stress relieving temperatures. Furthermore, in badly designed jobs failure has begun before the parts go to the furnace.

TABLE I

Contraction of Butt Welds, Inches

Thickness	Plate	Average	Minimum	Maximum
Arc	¼	.032	...	...
	½	.041	.029	.054
Gas	¼	.056	...	...
	½	.075	.073	.086

Any bosses, flanges, pads or the like attached to partition plates constitute with the plate a sub-assembly. These parts must be welded into a unit and stress relieved before assembly into the main structure. A stout ring like *Fig.* 3*b* and *c,* welded into a ¼-inch plate may shrink the plate as much as ⅛-inch. In fact it is practically impossible after a partition is in place to weld anything to it either by design or for repair without causing failure.

Carbon Steel Is Ideal

MATERIAL. In most cyclically loaded structures allowable stresses are determined by the allowable deflections which are evident as vibrations. Thus if a member in tension is 60 inches long and the allowable amplitude of vibration is .005-inch the allowable stress is only $(.005 \times 30{,}000{,}000)/60 = 2500$ pounds. It is evident, therefore, that in machines it will not often be practicable to utilize alloy steel for welded frames. This is fortunate since the ideal welding material is low carbon steel and for certain classes of work the use of more than .35 per cent carbon in steel is prohibited. There is comparatively little need for the introduction of alloy material into the welding shop but when required the engineer should specify also the kind of covered rod to be used and he should insist on qualification tests of welders using the special plate and rod.

Welds made on alloy steel are seldom any stronger than the plate and always less ductile. Consequently failures in the welds during welding, during stress relieving, or subsequently are common. Low-carbon steel may be welded with rods which give the weld considerably greater strength than the plate and remarkable ductility as well. Consequently adjustments during welding or stress relieving tend to take place harmlessly in the plate rather than in the weld.

DRAWINGS. Drawings are not necessarily designs for welding unless the designer has visualized each successive step in the fabrication. The job if complicated should be divided up into sub-assemblies, each of which is shown as an individual part to be welded and usually to be stress relieved before welding with other sub-assemblies to complete the unit. Naturally the final assembly is stress relieved once more. With his eye on the main result the welder all too often fabricates the body of the structure and then adds dangerously to the locked up stresses by welding on accessory structures or their fastenings. Even more often the pads for such adjuncts as galleries, platforms, handrails, lifting lugs, lubricators, oil filters and other accessories are applied to the carefully designed main structure by an uninstructed detailer or tracer with unhappy results.

Even though the sequence of welding and stress relieving operations originates in the welding shop, drawings should be made to record any such valuable experience.

Prediction Necessary in Design

Prediction of forces that will act upon the completed assembly of any machine or structure and the conditions under which these forces will be active is necessary for proper design. It is then necessary that we determine the stresses and distortion that will be created in the structure by applied forces. Finally we must select the material and determine the amount and shape of that material which will most efficiently provide a safe and useful service life for the projected machine or structure. Included in this final step is the selection and design of proper connections so that the parts of the machine may be assembled and act as a unit.

The designer of machines will find many types of model studies to be of great aid in executing his designs. Three dimensional models built of identical or similar materials may be loaded and tested just as the full scale structure might be tested. Models made of brittle material having a constant stress-strain relationship up to ultimate strength are useful in determining stresses on complicated sections. Rubber models may be used to demonstrate and study distortions. Several useful analogies have been developed which enable the designer to solve stress distribution problems by observation and electrical, hydraulic or other phenomena. The photoelastic method is especially valuable to the designer of machines because it enables him to determine and therefore avoid the points of stress concentration.

This material was abstracted from a paper presented recently by Fred L. Plummer, associate professor of structural engineering, Case School of Applied Science, Cleveland, before a meeting of the American Welding Society.

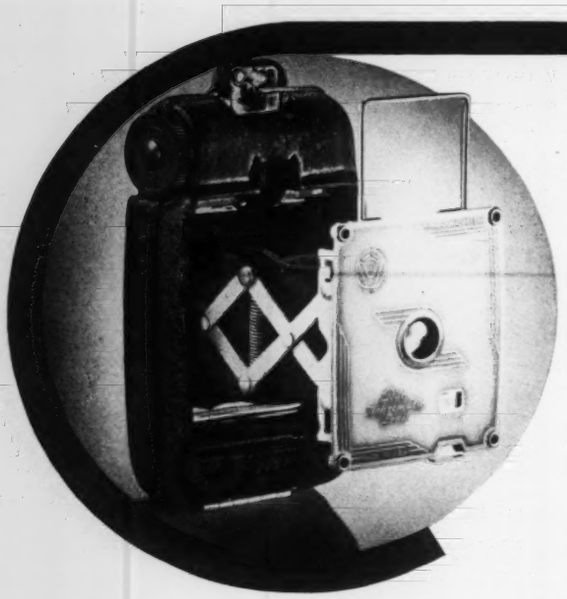


Fig. 1—Crinkle finish on this camera prevents light reflection and serves as a durable, attractive color

Color and Sales A

By R. H. Hookway

FOR centuries man has used colors to enhance the appearance of his handiwork. The Egyptians 5000 years ago were highly proficient in the use of pigments to bring out vivid colors. Articles found in the tombs of Egyptian kings along the Nile are finished in striking colors which can hardly be improved upon today. The temples of the Greeks in later years were adorned with colors. Brightly colored tiles and murals attest to the importance these people placed in color schemes and designs.

Not, however, until recent years have manufacturers of machinery, household articles and other products fully appreciated the benefits to be gained by scientific application of color. Locomotives remained huge, dirty eyesores until a few years ago. Machinery in plants was seldom given any other finish than a dull somber color which deadened the whole atmosphere of a factory. While automobile manufacturers dressed up their cars in scintillating hues, makers of thousands of other machines neglected to give this added touch which means the difference between sales and oblivion.

But now they are waking up. Today when the president of a concern is about to launch a new model on the market he will in many cases give as much thought to esthetic appeal as to mechanical performance. He realizes that today most of us are style and color conscious and that if his product is not pleasing to the eye it will not be accepted. An industrial designer or colorist may be called upon whose recommendations are based on research in style and color trends. With color preferences fluctuating with prosperity and depression periods, and differing with the upper and lower social strata, it is not an easy task to choose the right color combination. More than likely the designer will make a survey before making a recommendation. "Trying it on the dog" on a small scale can spare a lot of financial grief from a wrong guess, and help sales tremendously.

A simple example of the influence of color on sales was demonstrated years ago when British manufacturers offered to the South American market sewing needles packaged in black paper. The venture ended in a dismal failure. Shortly thereafter, German exporters packaged the British needles in red paper—and by the sole expedient of color captured and held this market until 1914.

Whether it be needles, sewing machines or presses, color can help to stimulate the sale of a product. Thorough analysis of all factors peculiar to its market will assist the designer in choosing those colors which are not only decorative, but functional as well. Colors not only create appealing beauty, they alter the apparent size or mass of a product, increase visibility and safety, influence radiation and light reflection, and promote user comfort.

In the great North American market the masses are uniformly conscious of beauty in the form of color. Surveys give evidence that the public possesses a fundamental esthetic sense and tends to favor pure colors

APPROPRIATE selection of color for a machine cannot be overestimated. Research shows that with suitable colors and color contrasts the popularity of a machine can be tremendously increased. Mr. Hookway, head of the Industrial and Transportation Color Service of the Sherwin-Williams Co., Cleveland, explains the psychological reasoning back of color schemes in this article

s Are Closely Linked

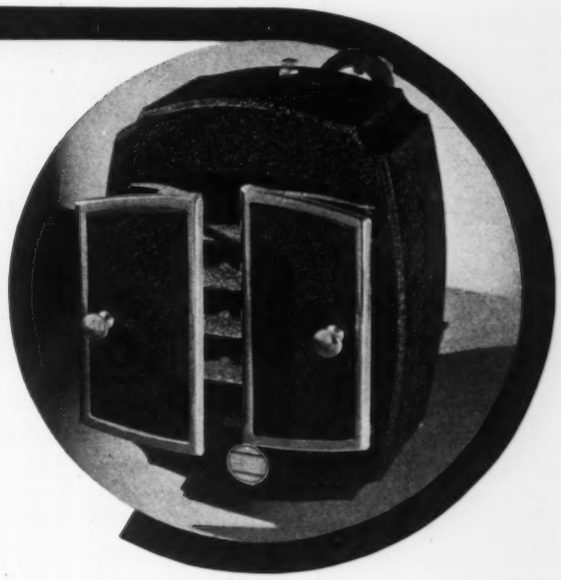


Fig. 2—Resistance to scuffing and heat makes a crinkle finish suitable for automobile water heater

rather than tints or shades.

That small group which constitutes the "prestige" market reacts to color more quickly than the lower strata, because culture and artistic surroundings have made the "prestige" group more keenly conscious not only of beauty, but of its absence. The cultured group normally shows a preference for the subdued tints and shades; but the hue which finds favor in this small group eventually becomes the style for the rank and file.

Popular taste is tempered principally by the condition of our economic structure. Strange as it may seem, bank clearings warrant a close examination by those who must specify product colors. Inspection of dwellings or motor cars built in the Coolidge era will disclose the exciting colors chosen during the so-called "boom" period. At that time manufacturers of tile were pressed by demands for the vivid colors which replaced "white" in bathrooms; motor car bodies blossomed forth in striking multicolored contrasts while wheel colors became too gaudy for words. On the other hand, the "depression" produced an array of somber colors, as any automobile catalog of that period will confirm. With improved business the popular taste now turns to cheerful hues. Fortunate is the firm whose designer can interpret the public pulse and thereby forecast the popular taste. Far easier than specifying the color of a product to meet the popular whim engendered by economic conditions, is the task of choosing color to meet climatic conditions.

TABLE I

REACTIONS TO COLORS

Men Prefer	Women Prefer	Children Prefer
Blue 45%	Red 42%	Blue 23%
Red 22%	Purple 16%	Red 20%
Purple 21%	Orange 10%	Yellow 18%
3% Green, Yellow, Orange, Black	Green 10%	Green 15%
	Blue 8%	White 13%
	Black 8%	Black 11%
	Yellow 6%	

In any climate color is "a maker of moods." For example—orange arouses a feeling of warmth. It has brightness, also dash and force. Where climatic conditions are predominately warm, the use of orange will emphasize the heat factor. Good judgment will prohibit the use of this color on machines operated where it would accentuate discomfort from existing heat. In such cases a color which produces a cool and tranquil mood finds favor. Table 1 shows how men, women and children react, in general, to different colors.

In cold climates, use of reds and yellows generates an atmosphere of comfort. Colors which contain no trace of reds or yellows are designated as "cool." In hot climates, the use of cool colors such as deep blues, greens, and grays tends to promote a restful atmosphere. Cool colors actually inhibit "warm" reflections.

Designers often think of markets in terms of metropolitan centers only. Frequently overlooked is the multitude of smaller communities, urban and rural, which constitute the fertile fields for increased sales of products that are dressed in proper color. Whether the product is for exterior or interior use; for home,

office or factory; in town or country—consideration must be given to the ultimate light surroundings of the article.

In urban factory and office, artificial light predominates as a means of illumination and experience has taught plant operators that white ceilings and walls give the maximum dispersion of light. In specifying finishes for machinery, designers should select those colors which reduce the monotony of factory environment; those colors which provide for safety, eliminate eye strain, inspire cleanliness and produce a feeling of physical comfort for the worker.

The use of black numerals on white keys and white numerals on black keys, over a red background—exemplified by the the new Todd Protectograph—provides contrast which transports the operator from the usual atmosphere of labor to that of interesting achievement. Legibility is improved, hence inaccuracies decrease. In Table II the degree of visibility of colors is compared.

TABLE II

Visibility	Decoration	Background
1	Black	Yellow
2	Green	White
3	Red	White
4	Blue	White
5	White	Blue
6	Black	White
7	Yellow	Black
8	White	Red
9	White	Green
10	White	Black
11	Red	Yellow
12	Green	Red
13	Red	Green
14	Blue	Red

To provide safety, better seeing, cleanliness and user comfort, the color which is applied to the machine must, from the surrounding light which falls upon it, reflect a hue that inspires the desired mental attitude in the user. Hence, the amount and intensity of illumination, natural or artificial, deserves careful estimation so that a discriminating choice of color can be made. Under one set of lighting conditions the designer may specify "ivory tan" for a product; under other conditions, "buff"; and under others "olive tan." Whatever color is specified for the product, the color's function lies in the degree and manner in which it reflects the surrounding light from the object.

Moreover, whether the product be for urban or rural location, whether illuminated by natural or artificial light, the most important phase of the designer's task in choosing a dress for the machine is *the selection of color with the correct reflection value.*

When you enter a dark room and switch on the light, boundaries and articles in the room become visible. These things do not create light, but they reflect the light which you have switched on. And the quantity of light reflected from any surface depends upon two factors: Reflection value of its color and reflection characteristic of its surface.

TABLE III

Light Reflection Values

Color*	Percentage
White	89%
Ivory	82%
Canary Yellow	77%
Cream	77%
Caen Stone	76%
Orchid	67%
Cream Gray	66%
Sky Blue	65%
Buff	63%
Pale Green	59%
Shell Pink	55%
Bright Sage	52%
Silver Gray	46%
Olive Tan	43%
Forest Green	22%
Cocoanut Brown	16%
Black	2%

*Based on readings using flat paint. Gloss shows lower diffuse and higher specular reflection values.

In choosing color, the functional use of the product must, of course, be ever present in the designer's mind. However, it is common practice to specify "red" for handles, knobs, switches, etc. connected with fire-prevention or other safety controls. Beyond exceptions such as these, the designer who specifies color becomes a dictator who decrees the percentage of light that will be reflected by all exposed surfaces.

To assist in the selection of correct colors for machines an exhaustive examination has been made of reflection factors which would indicate the percentages of light reflected by various colors. This chart of re-

Fig. 3—Streamline effect is obtained on this train by the correct use of color contrasts

flection values is an invaluable aid to designers. Reflection values reached for various colors are shown in Table III.

By its effect on the vision of the user, the light reflection value of color applied to machines can increase or decrease safety, as well as efficiency of workers. The light reflection chart provides a means of accurately comparing the reflection values of one color with those of another—thus facilitating choice of the most suitable color for practical use.

Gloss Increases Reflectivity

Surface characteristics of a product will also influence reflectivity. Light rays striking a flat mirror-like surface or finish are reflected almost intact—in much the same manner that a baseball striking a hard smooth surface, bounds off with a degree of force slightly less than that of its approach—the angle of approach determining that of its departure. High gloss paint of high reflection value which covers a smooth surface permits light to be reflected with little loss in intensity. It produces a glare which, from the standpoint of good seeing, is to be avoided. The trend to get away from gloss on typewriters, etc. is characteristic.

In contrast, a rough surface, or a smooth one on which a flat paint or crinkle finish has been applied as in *Figs.* 1 and 2, will scatter the light in a multitude of directions. This scattering or diffusion of light rays is the opposite of mirror-like reflection. Such diffusion of light minimizes glare. Machines on which close visual tasks are performed become instruments of torture when they cause glare.

In deciding on the finish, while a textured surface might be preferable from a visual standpoint, consideration must also be given to the added dirt-resistance and easy washability of smoother finishes wherever this is a problem. Perhaps the greatest percentage of product surfaces are restricted from approaching the ideal type by handicaps in manufacturing processes. In these instances the designer must rely on color finish to supply the deficit caused by the character of a product's surface. In fact, substantial changes in design have been avoided, and money saved, by achieving novelty and functional improvement through the application of proper color.

TABLE IV

Color	Harmonizes with
Brown	Gray, vermilion, orange yellow, turquoise
Gray	Tartar red, dark crimson, export blue
Mauve	Emerald green, dark brown, deep wine
Orange and Orange Yellow	Export blue, light blue, washington blue
Purple	Orange yellow
Tartar Red	Dark blue, gray, green
Yellow	Royal blue, chrome green med., boatswain blue
Cream	Dark blue, plymouth blue, chrome green med., 20th century red
Chrome Green Medium	Palm beach gray, cordova tan

A specific color arouses in man a specific response. Dark colors create a feeling of sturdiness or substance; light colors induce the opposite responses. Lighter colors tend to give an object the appearance of being larger or more spacious than deeper hues. Reds and yellows, "heat"; marine blues and forest greens, "cool"; pure gray is neutral. White generates a feeling of sanitary cleanliness; black, dignity. Certain colors tend to make soiling less visible. Correct use of contrasting colors can be made to accentuate "streamlined" or other desirable effects. The streamlining effect has been increased considerably by the use of proper color contrasts in the illustration of the "Comet" shown in *Fig.* 3. Protruding or accessory parts may be made more a part of the mass if not too contrasting. Table IV gives at a glance colors with those that harmonize satisfactorily.

Before specifying the product color, definitely and thoroughly, analyze the characteristics peculiar to all groups and sections that make up your market.

I. Will your product be offered to the "prestige" group, who incline toward "tints and shades"; or to the "masses" who usually prefer "pure colors"?

II. Will the economic condition of your market foster a desire for substantial, long-pull objects; or for "boom time," dashing gay products? Color can "make" your product either.

III. Where is your market located—city or country; home, factory, or farm? What is the climate; the illumination?

IV. Will reflectivity of the color lessen eye strain, increase efficiency, promote user comfort?

V. Will the product's color transport the user away from the drab atmosphere of toil?

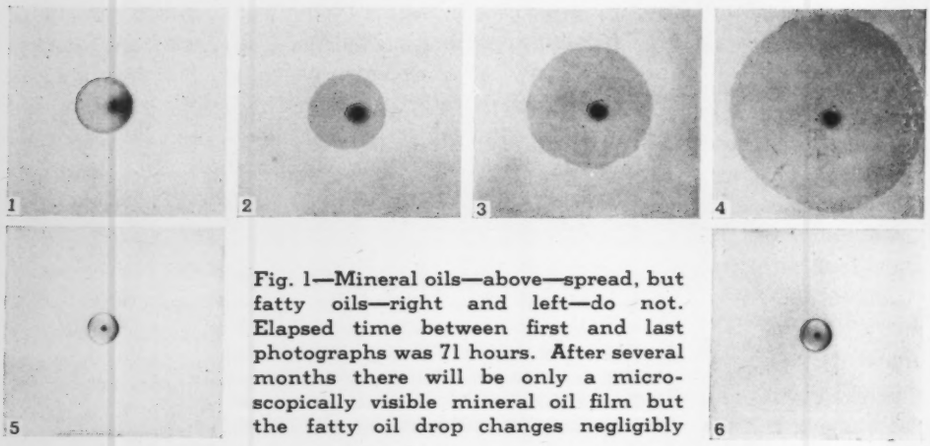


Fig. 1—Mineral oils—above—spread, but fatty oils—right and left—do not. Elapsed time between first and last photographs was 71 hours. After several months there will be only a microscopically visible mineral oil film but the fatty oil drop changes negligibly

Spreading of Oil Is Lubrication Problem

By W. E. Campbell

THIS is an abstract of an article appearing in the January issue of Bell Laboratories Record, based on fundamental studies on lubrication made by Mr. Campbell in the Bell chemical laboratories. Although made in behalf of telephone equipment, these studies are significant in connection with lubrication problems encountered by designers of food processing, textile and many other types of machinery

IF a drop of any of the oils in general use for lubricating purposes is placed on a horizontal metal surface and left for a week or two, it will be found to have spread out to a thin film of irregular shape several square inches in area. For a large majority of industrial applications the spreading tendency of an oil is not a property of great importance and has therefore been given comparatively little attention by oil manufacturers. It is however a serious disadvantage in the lubrication of machine switching apparatus and certain other types of telephone equipment, since it causes bearings to run dry too frequently, drives oil to parts where lubrication is undesirable and promotes the collection of dust. The development of oils which do not spread therefore becomes a matter of great interest

For some time investigation of the factors which influence the spreading of oils on horizontal metal surfaces have been under way at the Bell Telephone laboratories with the object of developing a non-spreading oil of high oiliness. A fundamental difference between mineral oils and fatty oils of animal and vegetable origin is that the mineral oils spread while the fatty oils do not. This difference is clearly brought out in *Fig.* 1 which shows successive photographs of drops of light mineral oil and of a fatty oil placed on a steel plate at the same time. *Fig.* 2 shows the spreading rates of a large number of oils. It will be noticed that all the min-

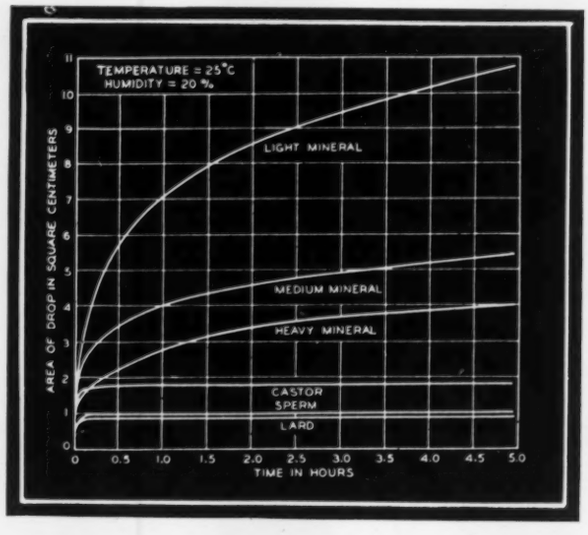


Fig. 2—Rate of spreading of various lubricating oils on steel depends on their viscosity

eral oils spread and that rate of spreading is dependent on viscosity. The fatty oils, on the contrary, do not spread after initial flattening of the drop, and equilibrium size of the drop is not related in any way to viscosity.

It would appear from these facts that a solution of the problem would lie in the selection of a fatty oil of suitable viscosity which would provide a non-spreading oil of high oiliness. Unfortunately however, fatty oils as a group are considerably less stable to oxidation than the mineral oils and tend to gum and to form corrosive acids to varying degrees. The work carried out recently in the laboratories has therefore been directed toward the development of blends of fatty oils with mineral oils or stable non-spreading organic liquids. A study has also been made of anti-oxidants or chemicals which can be added in small quantities to stabilize the blends towards oxidation. This work has yielded fundamental information of great interest concerning the nature of surface films on various types of solids.

When a drop of liquid is placed on a solid as in *Fig.* 3, its spreading behavior is determined by the relative values of the forces which tend to flatten it and those which try to draw it in. The former are gravity, and the surface tension of the solid and the latter are the surface tension of the liquid and that of the solid-liquid interface. The difference between the solid and the solid-liquid tensions is called the adhesion tension. This is extremely sensitive to small amounts of contaminants on the surface of the solid. Under ordinary field conditions this contamination is an adsorbed film whose thickness and composition depend on the humidity and state of purity of the air. This film modifies the adhesion tension and profoundly affects the spreading behavior of an oil. For example, a drop of mineral oil will spread much more rapidly on a steel surface which has been thoroughly freed from contamination than on one which has been exposed to the atmosphere for some time.

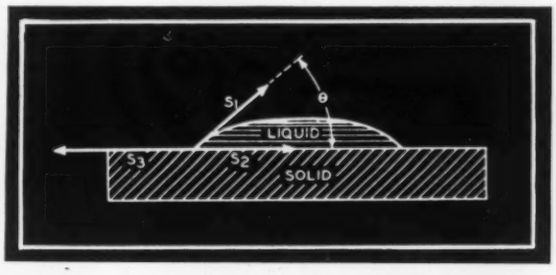


Fig. 3—Spreading of oil on solid surface depends on surface tension of liquid, S1, of solid-liquid interface, S2, and of solid, S3

The thickness of the adsorbed film of moisture on a solid varies with changing humidity and this also changes the adhesion tension. This is illustrated by the behavior of a drop of white mineral oil which will

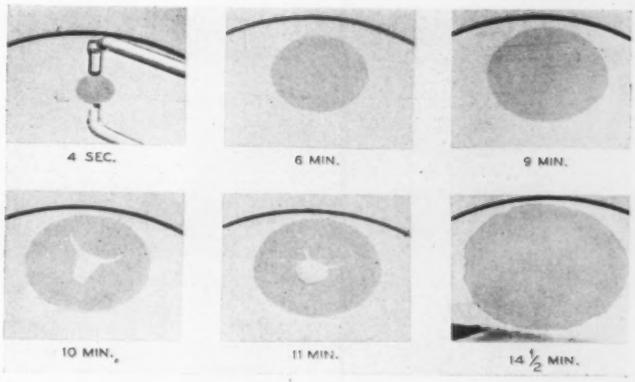


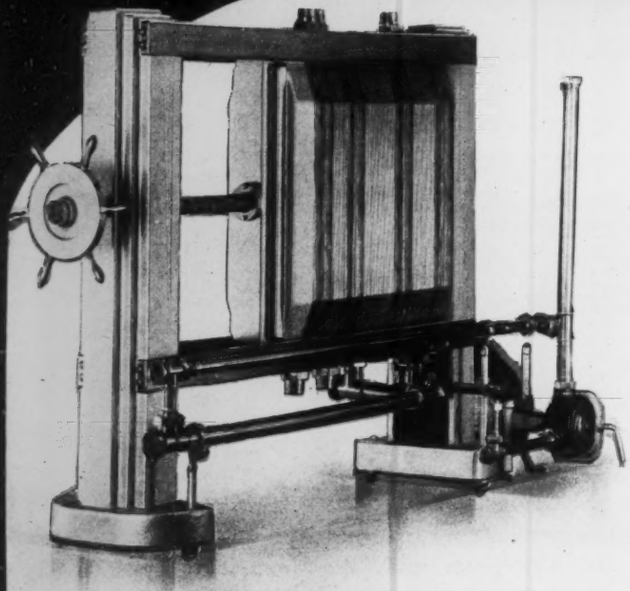
Fig. 4—Fourth and fifth photographs show retraction caused by addition of volatile vapor, while last shows resumption of spreading when moisture was added

spread indefinitely on clean glass in an atmosphere at 40 per cent humidity but if placed on the same surface in an atmosphere at 70 per cent humidity, it will stop spreading after a few minutes. If the humidity is initially low and the drop is allowed to spread until it is considerably greater than its equilibrium size at 70 per cent humidity, and the humidity is then raised to 70 per cent, the drop will retract to the equilibrium size.

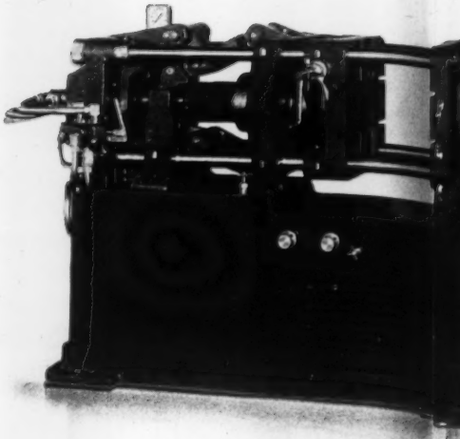
An interesting example of the effect of adsorbed vapor films in modifying the spreading of another liquid is shown in *Fig.* 4. The first three pictures are of a kerosene drop spreading on a steel plate in a dry atmosphere. Just before the third picture was taken drops of a volatile organic compound of a type which is strongly adsorbed were placed on the edge of the plate. Within a few seconds the central drop started to retract as shown in the fourth and fifth photographs. Moisture was then admitted to the atmosphere, at which time the central drop immediately started to spread again as can be clearly seen from the last photograph.

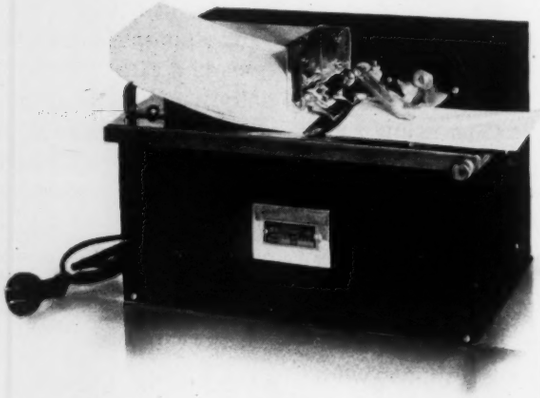
In studying non-spreading oils a capillary tube with an accurately ground circular tip is mounted one centimeter above a clean, highly polished steel plate which is maintained horizontal by means of a leveling platform. A drop of the liquid to be studied is formed slowly at the tip of the capillary by applying pressure to the liquid in an attached bottle and is then allowed to fall of its own weight on the steel surface. The measurements are made by determining the diameter of the drop at intervals with the aid of two parallel steel rods placed on a glass plate about five centimeters above the drop.

The first measurement is taken five minutes after the drop has been deposited and then others are made every hour thereafter for the duration of the experiment. The steel plate is cleaned by polishing it with a fine abrasive followed by a thorough rinsing with water and redistilled alcohol. It is then dried in purified air. This cleaning method gives a high and reproducible coefficient of static friction between steel surfaces which indicates freedom from surface contamination. The results shown in *Fig.* 2 were thus obtained.



Stainless steel finds wide utilization in the Cherry-Burrell milk pasteurizer, left, from the large side covers to the long pressure screw that squeezes the stainless steel plates together. Designed to operate at high pressures, the milk is efficiently sealed with rubber gaskets between plates, yet easily opened for cleaning.





Oilless bearings and castings of stainless steel have been incorporated into the Multipost letter opener machine, right, to obtain durability and efficient operation. The small driving motor is mounted on a Bakelite base, insulating it from the frame.

Design Fe in New Mo

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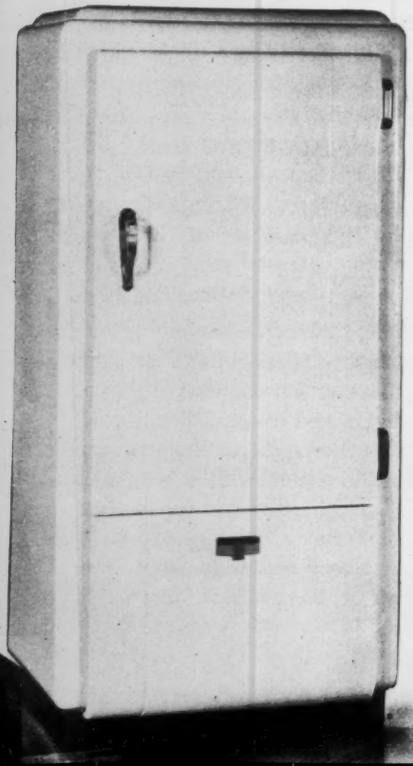
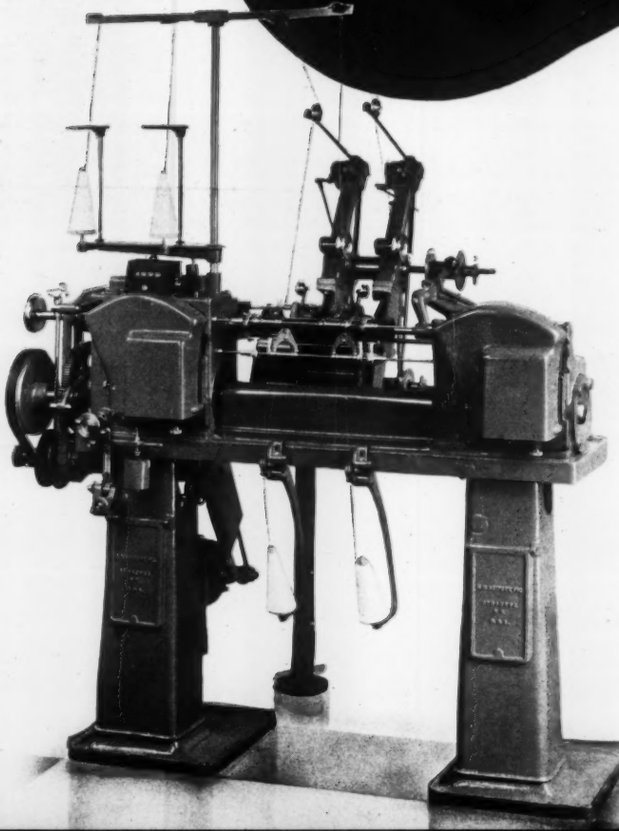


Greater operating efficiency has been obtained in the new Westinghouse refrigerator, left, by a Sanalloy froster unit. Materials used include micarta for door frame trims, rust resisting steel for shelves and a high grade porcelain inside finish.



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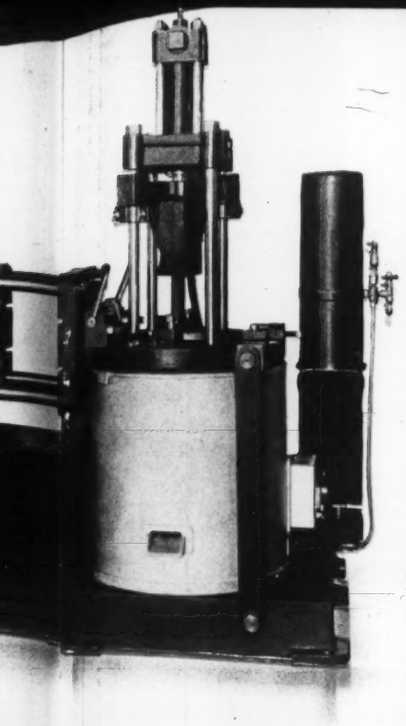
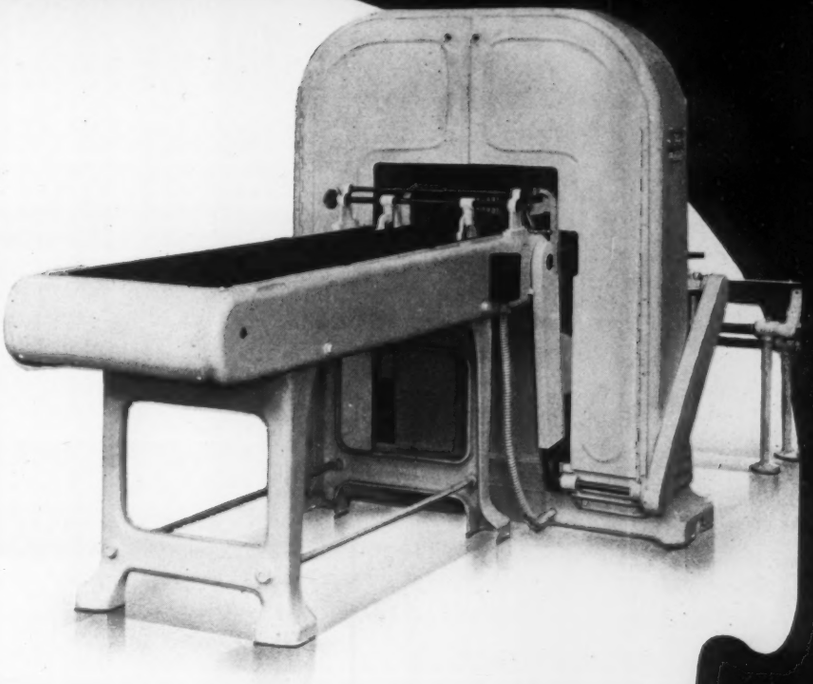


Hydraulic power is employed in the Lester die casting machine, left. All phases of the casting cycle are automatically controlled and easily adjusted by foolproof finger tip controls which allow for simple and quick changes of the die.

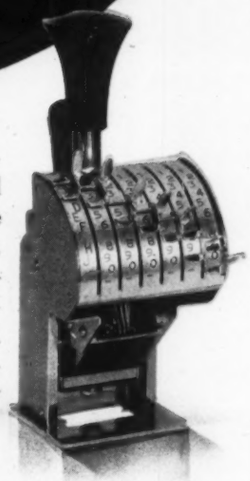


Thin multiple band saws running over semi-steel cones provide the cutting element in the Fay-Egan high speed bread slicer, above. Ball bearings in the slicer and oilless bearings in the conveyor obviate the need for frequent lubrication. Complete enclosure of working parts is evident.

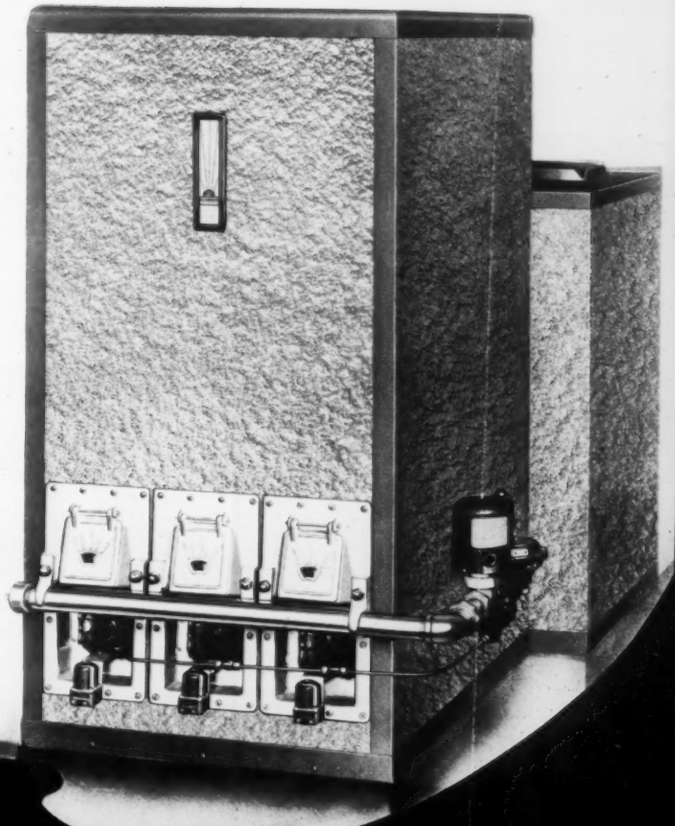
n Features Machines

tation of Recent Machinery tandpoint of Design.

One piece of molded black Durez plastic is used for the entire case of the American timer, above, not only for appearance but to resist hot fats, fruit acids or other substances which would stain. The timer is equipped with an electric meter which actuates a buzzer signal.



Speed of selecting numbers has been increased in this compact Force numbering machine, right, without sacrificing appearance or mechanical simplicity. A staggered number index is in direct view of the operator.



Welded steel heating elements are used in the Fox gas-fired air conditioner, right, to make a seamless leakproof unit. Each section of the element is formed under 500 tons hydraulic pressure. Green crystalline enamel gives the device an attractive and heat resisting finish.

Twin arrangement of cotton guides for coils of great length permits a high speed interweaving operation in the Seifert cotton winding machine, left. Speed ratio between the winding spindle and the cotton traverse guide cams is regulated by a variable speed unit.

New Machines Indicate Design Trends

Coloring of a machine so that its effect on the owner or operator will be pleasant and in accord with his mental state is coming in for thorough study by designers. Formerly paint was applied to a machine either in an unusually gaudy manner to attract attention or in the case of production machinery, in such somber colors that factories resembled prisons.

More consideration is being given as to how well a certain type of finish will wear on the user's nerves. The location in which a machine is to be used and the type of person that will be in contact with it are considerations that are dictating the choice of color. Oil burning units, for instance, are being given dashing colors to brighten dark basements, while the color of business machines which are in daily use is changing to a cheerful yet inoffensive hue.

Machines recently developed in addition to those on the preceding two pages include the following arranged by fields of application.

Air Conditioning

Humidifying unit, Rochester Mfg. Co., Rochester, N. Y.
Unit air conditioners, Carbondale division, Worthington Pump & Machinery Corp., Harrison, N. J.

Baking

Mechanical dough rounder, American Bakers Machinery Co., St. Louis.

Brewery

Beltless hoop drivers, Chas. S. Jacobowitz Corp., Buffalo, N. Y.

Chemical

Extractor, F. M. Bowers & Sons Co., Indianapolis.

Construction

Trailer type concrete mixer, Knickerbocker Co., Jackson, Mich.
Concrete slab finisher, Koehring Co., Milwaukee.

Dairy

Ice cream freezer, Cherry Burrell Corp., Chicago.

Domestic

Electric shoe-shining machine, Gibb-Lewis Co., Chicago.
On-the-floor carpet dyeing machine, Hild Floor Machine Co., Chicago.
Oil burning burner, Richardson & Boynton Co., New York.

Food

Rotary dryer for granular, crystalline or powdered materials, Link-Belt Co., Chicago.
Printing, casting and cleaning machine for candy production, John Werner & Sons Inc., Rochester, N. Y.
Spray drying machine, Bowen Research Corp., Garwood, N. J.

Foundry

Unit type arrestors, Parsons Engineering Corp., Cleveland.

Furniture

Deterger for cleaning upholstered furniture, Von Schrader Mfg. Co., Racine, Wis.

Industrial

Motion study camera and projector, Production Control Machine Corp., New York.
Automatic oil, gas or stoker boiler, Weil-McLain Co., Chicago.

Materials Handling

High-speed, close-headroom electro lift hoist, Electro Lift Inc., New York.

Metalworking

Pipe threading and cutting machine, Landis Machine Co., Waynesboro, Pa.
Horizontal boring and facing machine, Defiance Machine Works, Defiance, O.
Light duty presses, Colonial Broach Co., Detroit.

Office

Portable duplicator, Autocopy Inc., Chicago.

Printing

Roto vertical plate coating machine, Offset Products Corp., New York.

Restaurant

Counter type ice cream freezer, Russ Soda Fountain Co., Cleveland.
Glass washer, Markwood Bros. Mfg. Co., Minneapolis.
Carbonating unit, Carbonating Appliances Corp., Div. of General Bronze Corp., Long Island City, N. Y.
Two-minute steak tenderer, American Mine Door Co., Canton, O.

Textile

Rubber yarn coverer, H & B American Machine Co., Pawtucket, R. I.
Power burling table, Birch Bros. Inc., Somerville, Mass.
Air guider, Guider Specialty Co., New Haven, Conn.

Welding

Motor-driven single operator type arc welder, Lincoln Electric Co., Cleveland.
Welding machine, Federal Machine & Welder Co., Warren, O.

Good Working Conditions Are Concomitant with Successful Design

NOT to discredit the work of our predecessors in engineering departments, we must admit that some good design was accomplished under dim lights, between whitewashed walls, and with only the wooden T-square and triangles with which to work. But "old times are changed"—if one were to expect a designer of today to produce an effective layout under such conditions he would be doomed to disappointment.

It is fast being recognized that good conditions and good tools are incentives toward the best work. In a recent advertisement of one of the largest agricultural machinery manufacturers in the country considerable stress is laid on the fact that the engineering department is completely air conditioned. Evident too is the use of modern drafting machines throughout, as well as daylight lighting apparatus.

Similar conditions for creating initiative and effective thinking have been installed at an eminently successful domestic machinery establishment where only the highest class of design work is accorded recognition. This company spends thousands of dollars annually in developing new models and believes wholeheartedly that everything practicable must be done to assist its design staff.

There is not the slightest thought of "pandering" in these up-to-the-minute companies, as can readily be appreciated if one stops to consider that millions are made daily by the effective transfer of thought from brain to paper; only the best that is available in equipment and conditions are good enough to insure swift and sure transmission.

• • •

Design Trends

PRACTICALLY the same answer is given by different engineers in response to queries regarding current trends in design. Differences of opinion are apt to arise only in those cases where a new design feature gains a foothold on one type of machine before being accepted for many, and later almost universally.

The most significant of such widely-recognized trends is the surge toward "styling", with its accompanying feature of building-in. Mounting of motors and controls within the bases and frames of machines is a pertinent example of acceptance over practically the entire design field.

Among other developments rapidly gaining headway should be mentioned hydraulic operation, the use of welded and die cast parts, and the elimination of noise. One or more of these features are already accepted for many types of machines, and alert engineers are mindful of their probable spread.

Professional Viewpoints

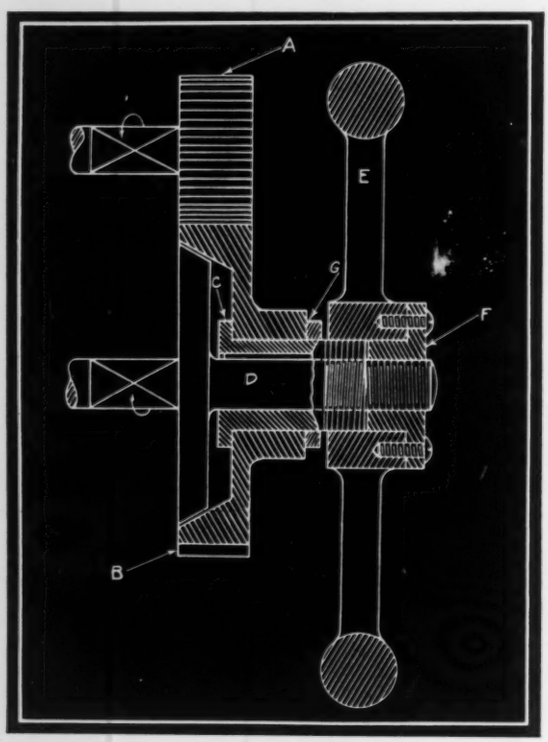
MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Unique Clutch Is Described

To the Editor:

NUMEROUS variations in clutches using the friction principle of engagement are designed annually to meet specific requirements on machines. Some are suitable for only the machine for which they were intended to be used while others, such as the type illustrated here, might be applied to other machines. The need in a wire working machine for shockless engagement with ease and rapidity produced this type of friction clutch. High frictional power transmission with a minimum of wearing parts were conditions that the designer had to meet.

Referring to the sketch, the gear *A*, which is the driving member, rotates in the direction indicated by the arrow, and meshes with the gear *B*. Gear *B* revolves idly on the flanged bushing *C*, which is splined



to shaft *D*, which is the driven member. The collar *G*, on bushing *C*, serves to transmit to gear *B* any axial movement which may be imparted to bushing *C*. The outer end of bushing *C* is externally threaded left-hand, engaging the internal thread in handwheel *E*. Shaft *D* carries a tapered disc which, in operating position, engages with the tapered recess in the gear *B;* normally there is a slight clearance between the tapered surfaces, as shown somewhat exaggerated in the sketch. The outer end of shaft *D* is threaded to engage the internally threaded, flanged bushing *F*, which is screwed to the handwheel *E*.

The operation of the clutch is as follows: When the clutch is disengaged, the gear *A* drives gear *B* which revolves idly on the bushing *C*, the balance of the mechanism remaining stationary. To engage the clutch, handwheel *E* is turned in the direction of the arrow on shaft *D*. As the thread on shaft *D* is right hand, the handwheel *E* will move to the left when turned. As the bushing *C* is threaded left hand, it also moves to the left when the handwheel *E* is turned, receding from the hub of the handwheel *E*, and carrying with it the gear *F* which engages the disc on shaft *D*. Due to the action of the right and left-hand threads, the movement of the bushing *C* out from the handwheel *E* is added to the movement of the handwheel *E* axially on the shaft *D*, thus producing considerable clearance between the frictional surfaces, when disengaged, by a slight rotative movement of the handwheel.

As the friction surfaces engage, handwheel *E* and the bushing *C* revolve with the shaft *D*. It will be noted that although the collar *G* must withstand the pressure of locking the friction surfaces together, there is no friction on any of the parts while the clutch is engaged, as they all revolve as a unit. To disengage the clutch, it is merely necessary to momentarily prevent rotation of the handwheel *E*.

—L. KASPER,
Philadelphia.

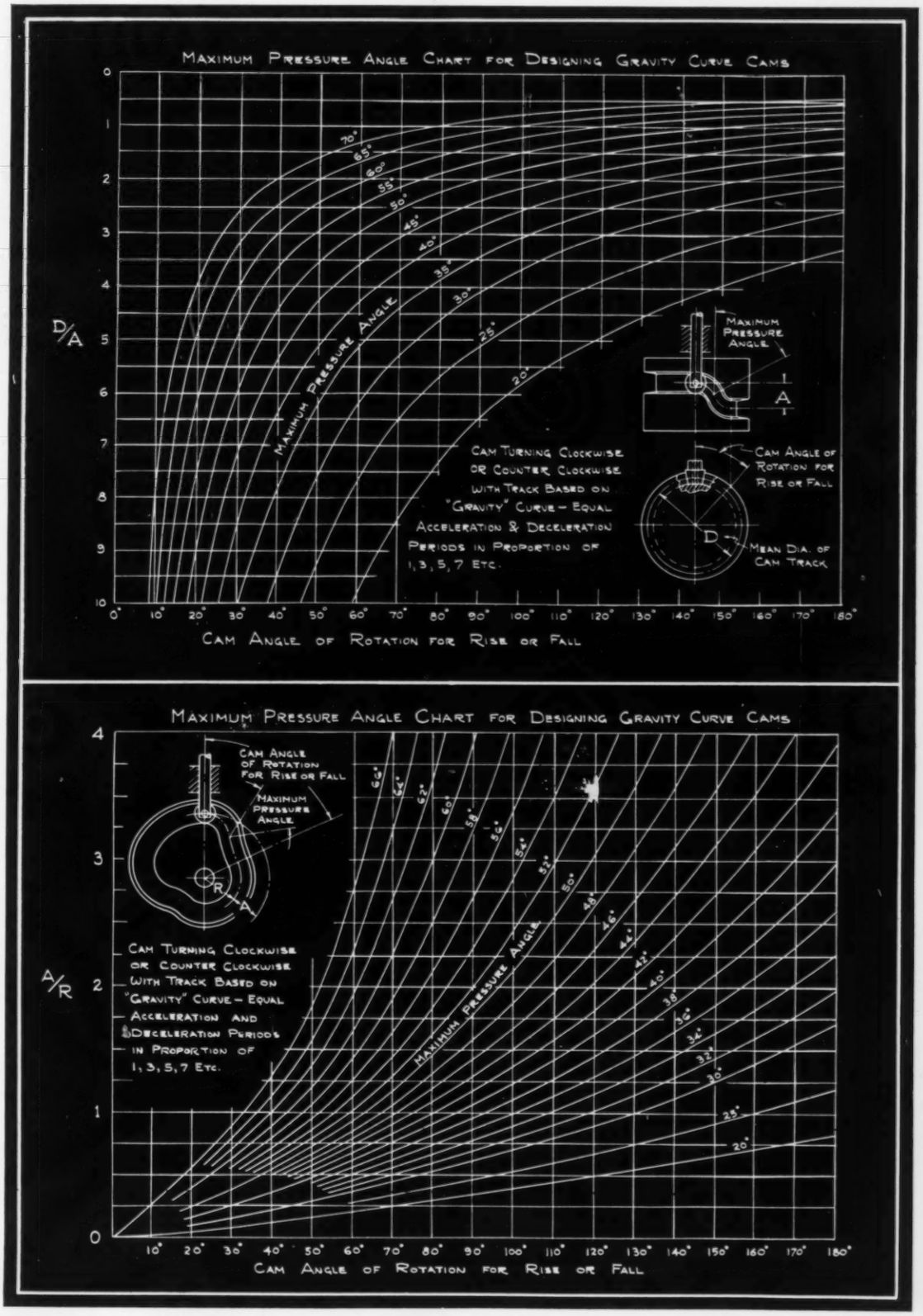
Charts Facilitate Cam Design

To the Editor:

IN THE May, 1936, issue of MACHINE DESIGN a graphic method of designing cams which obviates the old trial and error method was illustrated and explained. Continuing the development of charts for cam design I have constructed two more graphs from which the maximum pressure angle may be easily ascertained. Both of the cams in the two cases shown here are gravity curve cams designed to turn in either direction.

The results which may readily be taken from the charts are correct within two degrees. Ordinarily in cam design it is necessary to make a layout of the cam track. This is not only a time wasting procedure, but does not give the correct cam face without one or more layouts to check by. Similar charts to those shown here may be constructed for almost every type of cam follower.

—Frank Schubert,
Lynbrook, N. Y.



MEN of MACHINES

AFTER thirteen years with the Harnischfeger Corp., Milwaukee, during which he had experience in every department of the business, Frederick Salditt has been made a vice president of that company.

Mr. Salditt is a graduate mechanical engineer with a very wide circle of acquaintance among engineers, both in this country and abroad. He was educated at the Technical University of Darmstadt, Germany, and in the course of his many years of service with Harnischfeger he has traveled extensively. As export manager he has had to be thoroughly conversant with the design and operation of an unusually extensive line of equipment, including excavators, overhead cranes, hoists, welders, motors and generators. In addition to his duties as vice president, Mr. Salditt will continue to have supervision over the foreign operations of his company.

FREDERICK SALDITT

• • •

HEINRICH SCHNEIDER, recently appointed vice president and director of the Hooven, Owens, Rentschler Co., Hamilton, O., has a distinguished record in diesel engineering.

Following graduation from the University of Zurich, Mr. Schneider was for several years assistant to the famous scientist and engineer Stodola. Then he became development and research engineer for the Vulcan Ship & Engine Works, Hamburg, Germany. He returned to Switzerland in 1919 as chief engineer of Swiss Locomotive Works in Winterthur.

As research and development engineer for Fairbanks, Morse & Co. from 1927 to 1936, Mr. Schneider made notable improvements in their diesels. During 1936 he was assistant vice president of the American Locomotive Co., Auburn, N. Y., concentrating on diesel problems.

HEINRICH SCHNEIDER

• • •

WITH the advantages of engineering training and experience as well as long and intimate acquaintance with the industrial and managerial problems of the industry which he now represents, Tell Berna is well fitted for his new position as general manager of the National Machine Tool Builders' association.

Following graduation from Cornell University with a degree in mechanical engineering, Mr. Berna became connected with Cutler-Hammer Inc., Milwaukee. After having spent some time familiarizing himself thoroughly with the design, manufacture and applications of the electrical products of this company, he was made manager of their Cincinnati office. In that capacity he became recognized as an authority on electrical drive

TELL BERNA

and electrical control of industrial machinery.

Mr. Berna's direct connection with the machine tool industry began when he left Cutler-Hammer to become sales manager of the G. A. Gray Co., Cincinnati, builder of planers, with whom he remained for several years. Following a brief period with the Union Twist Drill Co., Athol, Mass., Mr. Berna came to Cleveland six years ago as general sales manager of the National Acme Co., continuing in that capacity until he took over the Association work at the beginning of the year.

♦ ♦ ♦

C. F. CHRISTOPHER has been appointed chief metallurgist of the American Locomotive Co., Latrobe, Pa.

♦ ♦ ♦

FRED H. FANNING has been made chief engineer of Lewis Foundry & Machine Co., Grovetown, Pa., succeeding FLOYD A. BEATTY who is now operating vice president.

♦ ♦ ♦

ADOLF GELPKE, assistant engineer since 1927, has been promoted to the position of chief engineer of the Autocar Co., Ardmore, Pa., with whom he began work in 1910 as blueprint boy.

♦ ♦ ♦

MERVIN J. KELLY has been appointed director of research, Bell Telephone Laboratories, succeeding OLIVER E. BUCKLEY who has been elected executive vice president.

♦ ♦ ♦

DONALD J. REESE, foundry engineer, formerly with the Whiting Corp., Harvey, Ill., has been employed by the International Nickel Co. to carry on research work on cast iron in the laboratory of this company.

♦ ♦ ♦

W. WAITS SMITH has been appointed executive engineer of the Studebaker Corp., South Bend, Ind. Mr. Smith, who has been with the company since 1925, received his technical education at the University of Michigan. His duties include direction of engineering budgets, new programs, engineering materials orders, service engineering and the experimental machine shop.

♦ ♦ ♦

RUDOLPH FURRER has resigned as industrial engineer of the manufacturing department, Allis-Chalmers Mfg. Co., Milwaukee, to rejoin A. O. Smith Corp., with whom he was connected from 1918 to 1932. (Note: A biographical sketch and photograph of Mr. Furrer appeared on Page 48 of the September, 1936 issue of MACHINE DESIGN).

♦ ♦ ♦

J. ORMONDROYD has resigned as experimental division engineer, Westinghouse Electric & Mfg. Co., to become professor of engineering mechanics, University of Michigan, Ann Arbor, Mich. (Note: A biographical sketch of Professor Ormondroyd will appear in the March issue of MACHINE DESIGN.)

♦ ♦ ♦

DR. ALEX DOW, president of the Detroit Edison Co. and past-president of the American Society of Mechanical Engineers has been awarded the Edison medal for 1936 by the American Institute of Electrical Engineers.

Obituaries

J. F. MAX PATITZ, chief consulting engineer, Allis-Chalmers Mfg. Co., Milwaukee, died suddenly on January 3. He was associated with Allis-Chalmers for more than fifty-one years, twenty-six of which he served as consulting engineer.

Mr. Patitz was born at Mugeln, Saxony, in 1866. After finishing a course in the Royal Gymnasium of Dresden, he came to the United States. He found employment in Pittsburgh where he spent four years in various factories and machine shops. Coming to Milwaukee he entered the employ of the E. P. Allis Co. in June 1885. Transferred to the engineering department Mr. Patitz became one of the designing engineers.

In 1901 when the E. P. Allis Co. became part of the Allis-Chalmers Co., he was placed in charge of the building of steam engines and compressors. As early as 1899 Mr. Patitz saw the possibilities of the steam turbine and in 1902 was sent abroad to investigate the existing types. On his return he did much to further the building of steam turbines by the company.

Mr. Patitz was a member of the American Society of Mechanical Engineers since 1891. He was also a member of the Society of Automotive Engineers and the Verein Deutscher Ingenieure.

♦ ♦ ♦

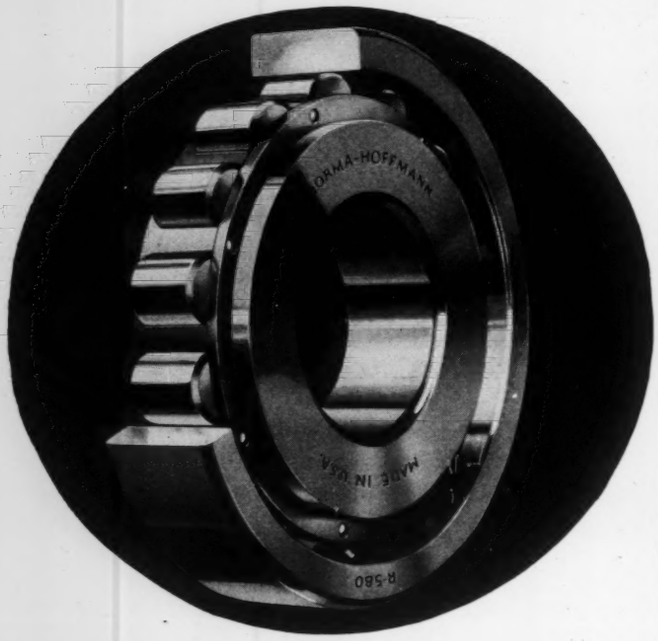
DR. CHARLES LEGEYT FORTESCUE, consulting transmission engineer of the Westinghouse Electric & Mfg. Co., died in his home in Pittsburgh on December 4.

Born in York Factory, Canada, Nov. 7, 1876, he received his earlier education in Dawlish, South Devon, England. In 1898 he received his Bachelor of Science degree from the Queen's University, Kingston, Ont., and then joined Westinghouse.

Dr. Fortescue was internationally famous for his work in curbing the effects of lightning on transmission lines and distribution systems. One of his great contributions was the development of that branch of mathematics known as symmetrical coordinates, which is of great value to educational institutions as well as to practical industry. Nearly 200 patents were credited to him covering a wide range of research, product development and protective devices.

For . . . .

SHOCK LOAD and HEAVY DUTY



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BALL, ROLLER AND THRUST

Assets to a Bookcase

Welding Technology and Design

By A. F. P. Fox and F. Bloor, published by J. P. Lippincott Co., Philadelphia; 90 *pp. Available through* MACHINE DESIGN *for* $1.50 *plus* 15 *cents postage.*

Welding no longer is a novelty but there still are many who could profit by the application of welding to their engineering problems. By making it possible to fabricate a product differently and better and by performing operations which previously were difficult or impossible, welding is constantly opening up new design possibilities.

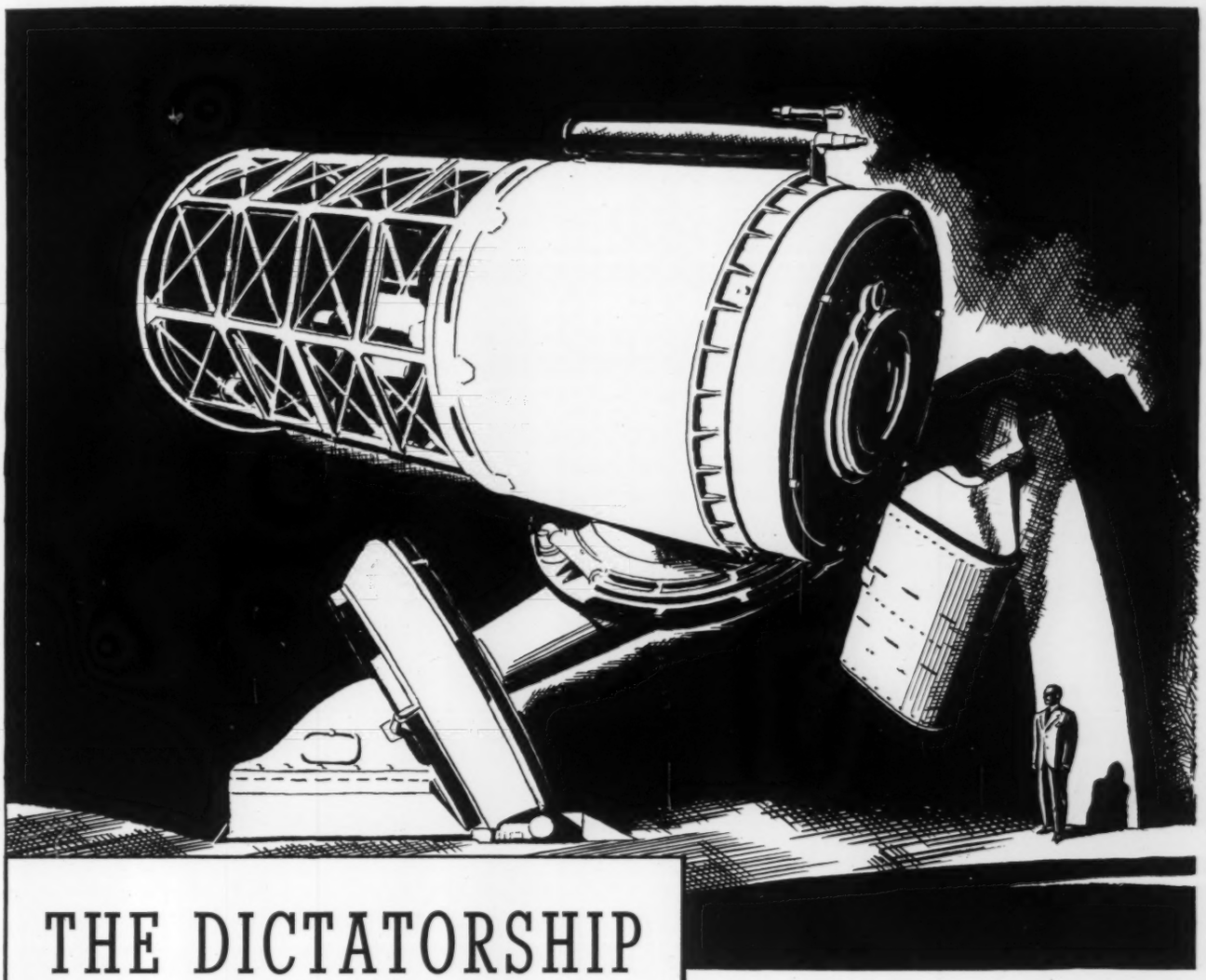
Good technical design is based on knowledge of the methods of welding, types and properties of welded joints and the metallurgical and mechanical effects of welding. In this respect this book is particularly helpful. In addition it discusses the welding of the various metals, the different types of machines used and the inspection and testing of welds. Finally it deals with the application of welding in the structural, electrical, automotive, general and shipbuilding fields. Methods shown in this book offer infinite ideas for the application of welding in these fields.

Plasticity

By A. Nadai and A. M. Wahl; published by McGraw-Hill Book Co. Inc., New York; 392 *pp.; available through* MACHINE DESIGN *for* $5.00 *plus* 15 *cents postage.*

This book presents to engineers and designers the fundamentals of the theory of plastic flow in materials, especially in metals. It is concerned with one important part of the theory of strength of materials and is based on the best methods of engineering mechanics and on the most up-to-date results of laboratory tests. It embodies the Dr. Nadai's experience of nearly ten years at the Institute of Applied Mechanics of the University of Goettingen, where the applied sciences under Felix Klein and L. Prandtl have been so highly developed. It also embodies Mr. Wahl's experiences for three years in the research laboratories of the Westinghouse Electric & Mfg. Co.

This book which is based on the original German edition, amplified and enlarged by the addition of new information, first brings together the observations of engineers, metallurgists and physicists regarding the plastic deformations of metals. It then summarizes the laws, as they are now recognized, for the more exact prediction by engineers of the distribution of stress.



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● QUALITY is a dominating influence—every master craftsman is an example to prove this. Once the ideal of quality takes possession of a man or an institution, it becomes a fixed idea controlling all activity.

All of America's great telescopes, popular symbols of precision, have been built by one or two concerns as a sideline to their regular businesses. But these firms were notable for precision workmanship.

Though Super-Precision Ball Bearings constitute only a small part of M-R-C ball bearing production, they influence the methods and the standards of workmanship in every department. Every M-R-C Ball Bearing is a better bearing than it would be if M-R-C Super-Precision bearings did not exist.

You may not need Super-Precision Ball Bearings for your own product—but remember that M-R-C can furnish whatever bearing your product may require . . . Standard, Selected, Precision or Super-Precision.

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M-R-C SUPER-PRECISION BALL BEARINGS ESTABLISH NEW STANDARDS OF ACCURACY

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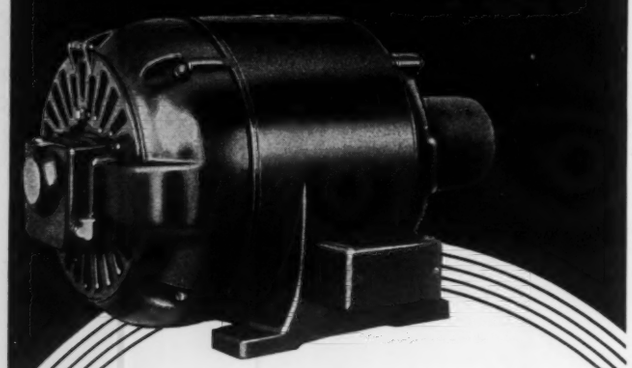
"That have what it takes"



IF YOU are interested in a worthwhile proposition on motors "that have what it takes" come to Peerless.

For more than 43 years Peerless has stood for quality electrical equipment and leading manufacturers of motor driven devices are using Peerless motors because they have confidence in them. They have found through test and experience that these motors carry the load with plenty to spare. *You can rely on Peerless.*

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Noteworthy Patents

ALEXANDER G. HERRESHOFF of Grosse Pointe Village, Mich., has been granted patent No. 2,034,757 covering improvements to clutches of the fluid type. This patent, which has been assigned to the Chrysler Corp., provides means for frictional engagement between the fluid clutch members at a predetermined speed of rotation.

The manner in which this is achieved is shown in *Fig.* 1 in which the view to the left is a side view of the lower half of the clutch sectioned on its axis, while that to the right is a partial front view of the inner member of the clutch showing the friction shoes. *A* is the casing driven by the engine or other prime mover. This embodies the vane structure *B* which by means of the liquid within the case, cooperates with vane structure *D* of inner member *C* to effect a drive between the two

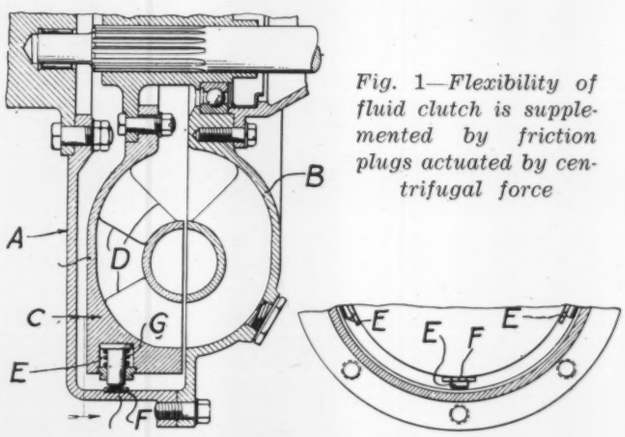


Fig. 1—Flexibility of fluid clutch is supplemented by friction plugs actuated by centrifugal force

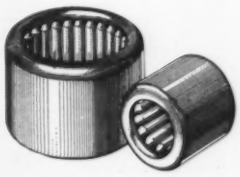
members as the centrifugal force of the liquid builds up.

Around the periphery of inner member *C* are spaced supplementary driving means *E*, those in the model illustrated being radial plugs. Normally these are held clear of friction ring *F* by springs *G*, but as the speed of inner member *C* increases under the influence of the "liquid connection," centrifugal force causes the plugs to overcome the spring pressure. Thereupon they extend outward, eventually coming into frictional engagement with ring *F*.

The general effect claimed for this combination is

This new bearing is

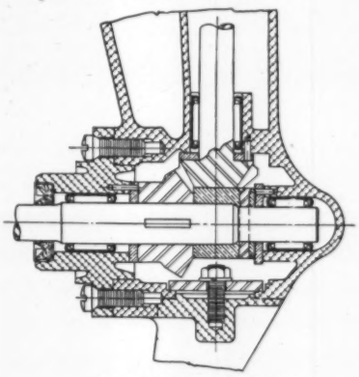
Remarkable For Its Size



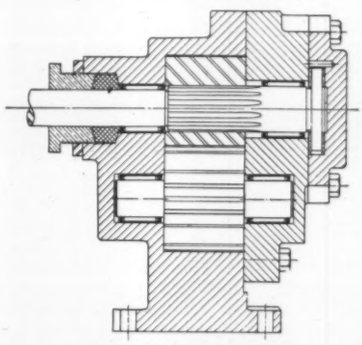
THE COMPLETE UNIT IS SMALL IN SIZE, LIGHT IN WEIGHT, COMPACT. THE IDEAL BEARING SHOULD NOT BE LARGE.

TORRINGTON engineering has successfully combined the essential features of a good anti-friction bearing, *plus* the major advantages of a bronze bushing into the single compact unit of the new Needle Bearing.

The Torrington Needle Bearing is truly remarkable for its size. Its advantages will be immediately apparent in the comparison with a ball bearing and bronze bushing for equivalent radial load and speed shown below.



OUTBOARD MOTOR



FLOATING GEAR PUMP

Applications of the Torrington Needle Bearing Show Importance of Its Size.

	O. D.	I. D.	Axial Length
Torrington Needle Bearing No. B-1616	1¼″	1″	1″
Ball Bearing No. 405	3.15″	.98″	.83″
Bronze Bushing 3 sq. in. area of bearing surface	1⅞″	1½″	2″

Because of the relatively small diameter of the rollers and the thin, tough shell of the retaining race, *the complete bearing requires no more space than a simple bronze or Babbitt unit.*

The increase in loads and operating speeds which the Needle Bearing makes possible because of its high unit capacity is a *definite advantage.*

The attendant reduction in weight is also important. The bearing itself is lighter—contributing directly to reduction in weight of moving parts. In addition, need of a large complex housing structure is eliminated, reducing weight of surrounding members.

Accuracy in Manufacture

Exceptionally close tolerances are necessarily required throughout the Torrington Needle Bearing because of the precision applications to which it is adaptable. The manufacturing tolerance of the bearing assembly is held within the inspection limit of .0009″. The accuracy of Torrington manufacturing methods, based on more than seventy years of experience in precision work, insures strict adherence to this figure.

More than three years have been spent in developing and perfecting the Needle Bearing, making exhaustive tests of every description for both rotation and oscillation, determining optimum measurements to tenths of thousandths. This experience and the facilities of the Torrington Engineering Department are at the disposal of all interested in adapting the Torrington Needle Bearing to their product.

* * *

Torrington engineers will welcome the opportunity to cooperate with manufacturers in developing designs and planning assemblies.

FEATURES OF THE TORRINGTON NEEDLE BEARING

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Small Size
Ease of Installation
High Radial Load Capacity
Efficient Lubrication
Low Cost

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Further information and data on the new Torrington Needle Bearing, the types and sizes available for immediate shipment from stocks, etc., is available on request. Write for Catalog No. 9.

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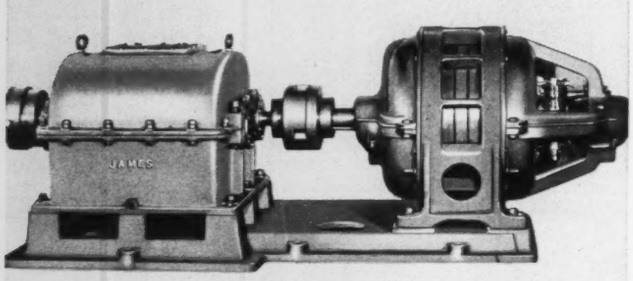

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that it gives the smooth starting and flexibility under fluctuating load which is characteristic of the fluid clutch—or "fluid flywheel" as it sometimes is called—plus the more positive drive of a friction clutch once the machine is up to regular operating speed.

PATENT No. 2,057,091, granted to Richard H. Eurich and Richard Aubrey Jr. of Youngstown, O., and assigned to the Youngstown Sheet & Tube Co., covers a method and apparatus for detecting subsurface defects in ferrous metals—particularly in welded seams.

A sectional elevation of the apparatus in action on a welded pipe is shown in *Fig.* 2, the movement of the machine being from left to right along the pipe. At the front of the chassis, supported on rubber-tired wheels, is a powder collector and distributor *A*. This is made up of a cylindrical housing provided with cover *B* and a conical hopper bottom with outlet at *C*. Within housing *A* is a baffle cylinder which has a spiral radial fin *E*. This baffle cylinder also has a conical hopper bottom. Nesting within the inner or baffle cylinder is a metal cage *F* carrying a corrugated filter screen. This screen assembly is supported in such a manner that it is shaken by an oscillating mechanism consisting of a vertical rod *G*, a connecting rod *H* and eccentric *J*, the latter being at the upper end of the motor shaft of the suction unit *K* at the rear of the machine.

This suction unit is similar to a vacuum cleaner, embodying as it does a suction fan *L*, mounted on the lower end of the motor shaft, and nozzle *M* which rides close to the surface of the work being tested.

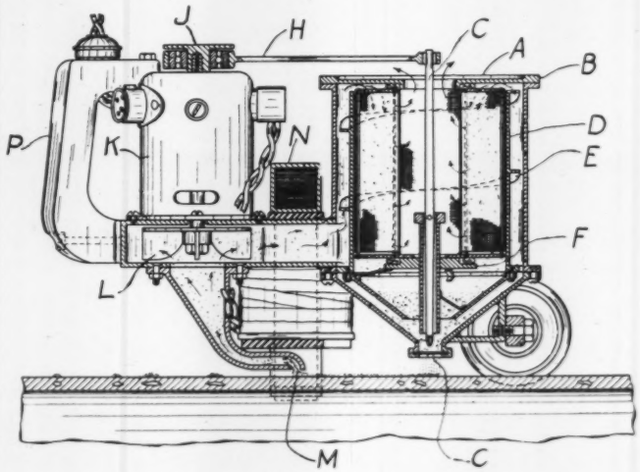
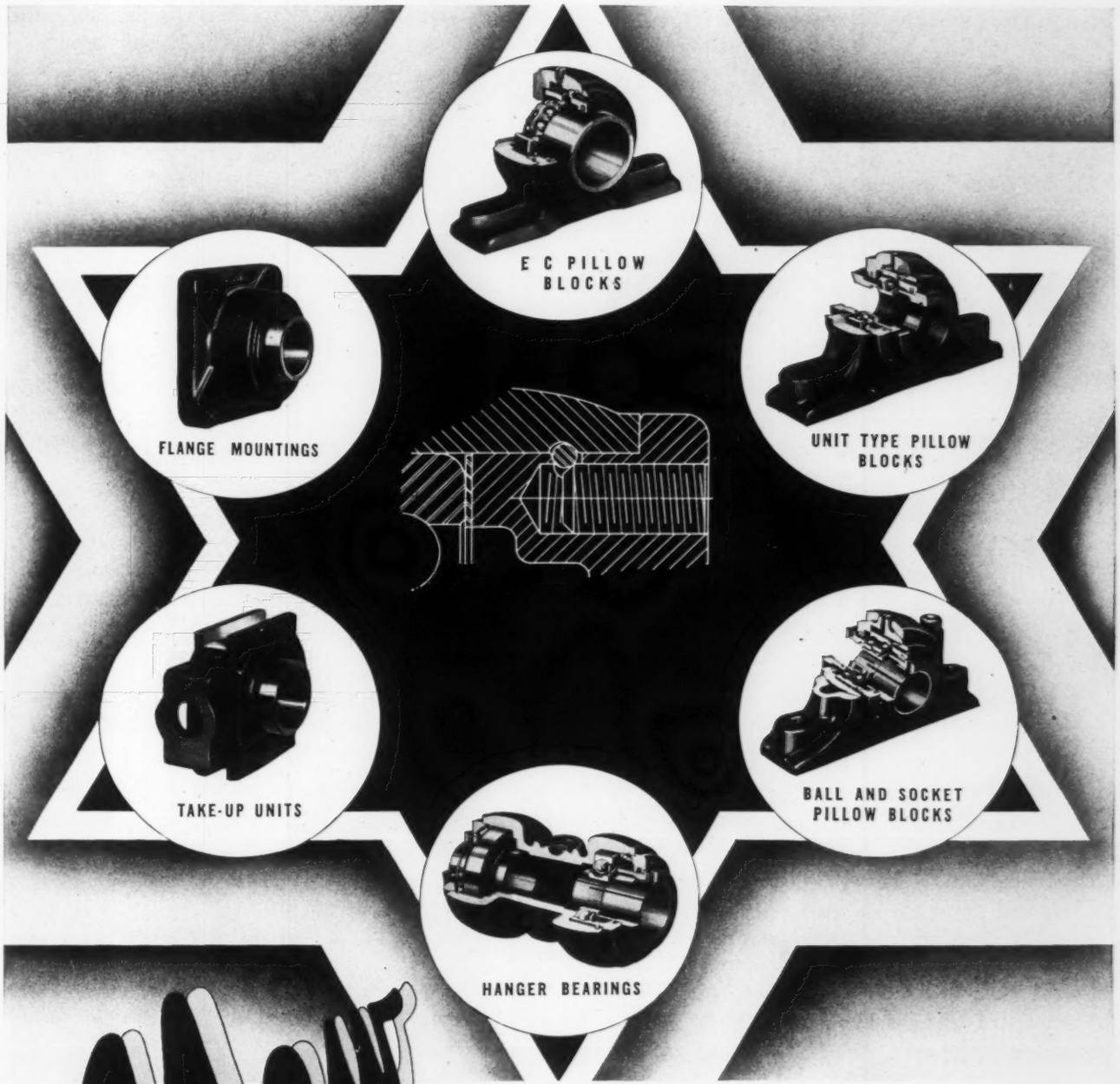


Fig. 2—Subsurface defects can be detected by machine which leaves traces of powder at defective areas

The third important element is U-shaped electromagnet *N* the poles of which are in close proximity to the



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Imagine, for example, the advantages of being able to select from three distinct types of Pillow Blocks any one of nine different capacities for a given shaft size. This unusually wide range of capacities and types (see above) together with many other new and revolutionary features makes the C J B line the logical one to consider in your plant or product modernization programs.

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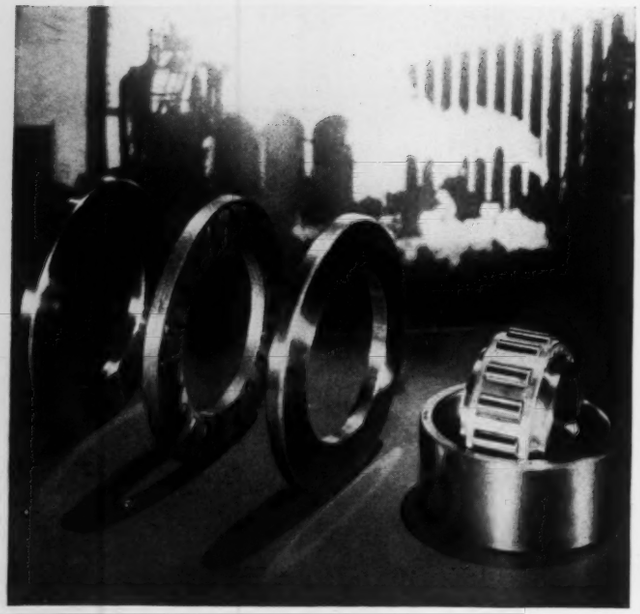

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CYLINDRICAL ROLLER

ROLLWAY BEARINGS

work being tested setting up therein a magnetic effect which is temporary in the solid metal but which is inclined to dwell for a time at points where there are flaws. The result is that when the paramagnetic powder is sifted down through a screen at outlet *C*, as the machine is pushed along the work by handle *P*, spots of powder over the flaws are not picked up by the suction nozzle which otherwise clears it up. The points at which these small heaps of powder adhere are then marked for further investigation.

Powder Is Recovered

The powder removed from the clear parts of the work is blown back into the powder collector and distributor *A* where it is trapped and deflected downward by radial fin *E* on the baffle cylinder. The air blast escapes through the corrugated filter screen and is exhausted through the central opening in cover *B* of distributor *A*. Arrows in the cut indicate the flow of the air.

Alternating current of 25 cycles is recommended as it gives good flux penetration and by releasing and renewing the magnetic grip fifty times per second it allows the apparatus to be pushed over the work by hand with relatively little effort.

ELMER C. KIEKHAEFER of Milwaukee has been granted a patent—No. 2,059,244—covering an automatic brake for use on the armature shaft of an electric motor. This has been assigned to the Stearns Magnetic Mfg. Co.

Reference to *Fig.* 3, showing the brake attached to an armature shaft, gives a clear idea of the design and mounting. It will be noted that housing *A*, shown in section, is fastened to a mounting ring *B*. This in turn is bolted to a special motor end plate (not shown). This ring *B* also serves as one of the stationary brake disks.

The other clutch disk takes the form of pressure plate *C*. This has lugs extending from each side which are guided in forked arms extending from the face of mounting ring B, thus keeping pressure plate *C* from rotating. These lugs and forks do not show in the cut, having been cut away at the front in this section and being hidden behind the mechanism at the back.

Disk Is Stiff

Interposed between the annular brake surfaces of elements *B* and *C* is a rotatable brake disk *D* of stiff friction material requiring no backing plate. At the center of this disk is a square hole which is a sliding fit on square block *E*, which has a hub splined to the armature shaft of the motor.

The brake disks are normally subject to braking pressure. Plate *C* has at its axis an integral sleeve *F*

Our PROBLEM...*Your* PROFIT!

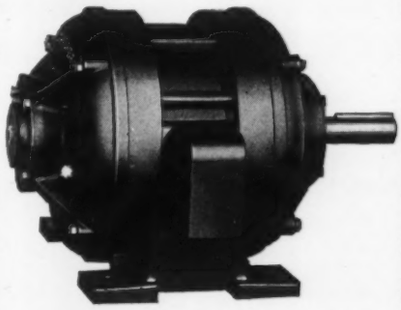
Thirty years ago we were confronted with a serious problem. We built a vast line of rugged power-driven machinery for such tough jobs as rock and ore crushing plants, for the mining and metallurgical industry, for pumping, for cement and saw and flour mills, just to mention a few of them.

Our machinery was designed and built for these tasks and was easily equal to them, but we had to have a motor that could take the beating that these applications required and measure up to the standards demanded by Allis-Chalmers Engineers.

The problem got worse and bigger until it resolved itself into one answer... to build our own motors. It was thirty years ago that we set about meeting our need . . . and did it.

Through this period of thirty years, the progressing knowledge and experience of all the various departments of our vast and diversified engineering organization have surely and painstakingly been built into Allis-Chalmers Motors, making them the sturdiest motors on the market—bar none.

Their great mechanical strength reduces maintenance costs to the minimum and extends their life beyond that of all less sturdily constructed motors. That is why, today, Allis-Chalmers Motors EXCEL and are the most profitable motor buy on the market.



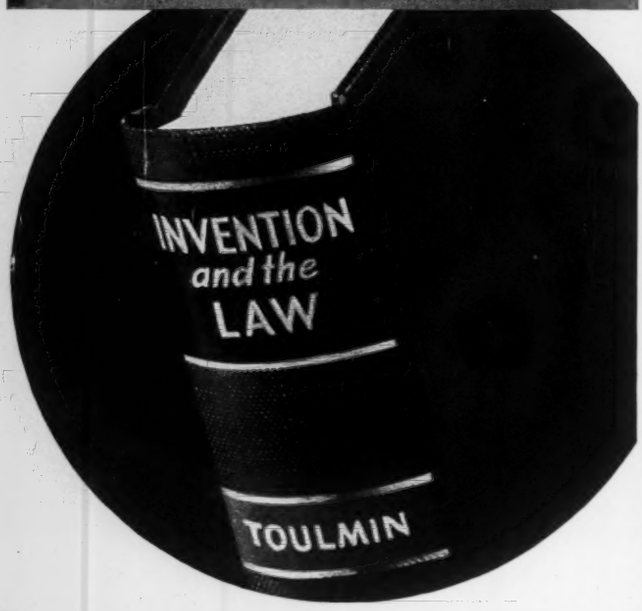
The Allis-Chalmers Mfg. Co. builds standard motors of every type from 1 hp. up—also motors for special application.

MOTOR DIVISION

ALLIS·CHALMERS

MILWAUKEE WISCONSIN

Let this Great Book Save You Time and Money!



EVERY DAY this Toulmin book can help you. Dont just THINK you have a patentable invention . . . KNOW! Learn when Design is NOT Invention.

An opportunity is lost—because somebody lacked clear understanding of the true characteristics of Invention. Time and money are wasted—on an "invention" which could never satisfy the legal definition of the term. EVERY manufacturer might profitably know MORE about the essential principles of Patentable Invention. INVENTION AND THE LAW is unique—a convenient manual answering the various perplexing questions as to what is, and what is not, patentable invention.

Complete, Clear, Accurate

Here is a book that gives you a clear and understandable statement of the RULES on each invention question. It summarizes, in a single volume, the findings of the Federal courts—classified for ready reference. Two outstanding sections in particular: *What Is Invention* and *What is Not Invention* make the work invaluable.

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Sent on 5 Days Free Approval

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Dept. 1P-22, 70 Fifth Ave., New York, N. Y.

into the bore of which is threaded spring abutment plug *G*. Stem *H* of this plug is a sliding fit in spring seat bushing *J* and has a screw driver slot for adjusting it. Surrounding the stem is compression spring *K*, pressure of which is regulated by screwing bushing *H* in or out by using a wrench on its hex flange. Thus torque of the brake is regulated.

Sleeve *F* of pressure plate *C* is slotted at *L* to accommodate a cross pin connecting the two sides of split lever *M*. *M* is loosely fulcrumed on cap screw *N*, with rubber cushion *O* between the lever and its abutment. The cross pin in *M* engages a shallow groove across the end

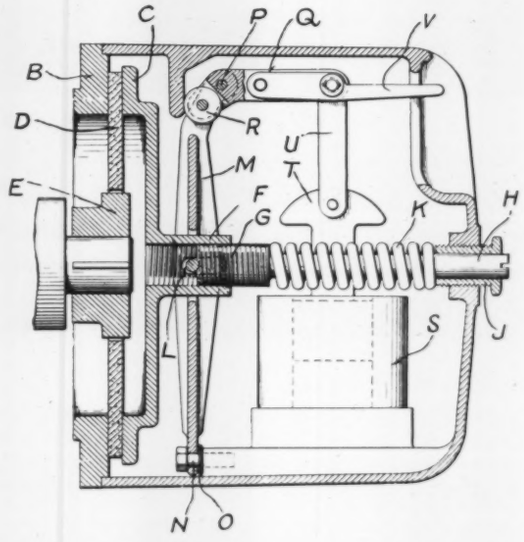
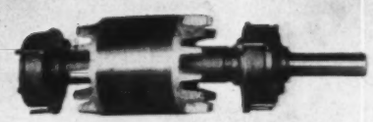


Fig. 3—Solenoid is utilized for actuating brake mechanism on armature shaft of motor

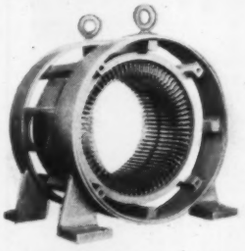
of plug *G*, which keeps the plug from turning except for adjustments.

At its upper end lever *M* carries a second cross pin *P* upon which is pivoted cam lever *Q*. This carries roller *R* acting against a fin in the casing in such a manner that when lever *Q* is moved clockwise the brake pressure is released. This action is effected automatically by vertical solenoid magnet *S* whose armature *T* is connected to the outer end of cam lever *Q* by link *U*. The solenoid is energized when current is switched to the motor thus releasing the brake and allowing the motor to start. Upon disconnecting the motor the solenoid is de-energized, thereby allowing the brake to act.

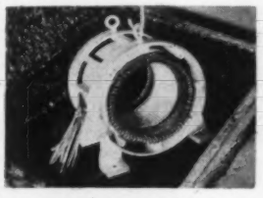
The extension *V* on cam lever *Q* is a pointer the end of which protrudes through a vertical slot in the end of housing *A*. This gives visual indication of whether the brake is on or off, and also shows by its position when brake adjustment is necessary. In addition it serves as a hand lever by means of which the brake can be operated manually. By pushing extension *V* laterally into a notch at the bottom of its slot the brake can be locked in "off" position.



Dust-tight cartridges protect the ball bearings from dirt. Rotor bars, short-circuiting rings and fans are cast of aluminum as a single unit of uniform structure without joints.

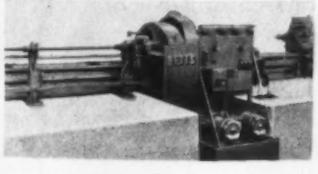


To insure permanent alignment and uniform air gaps, the stator core is mounted in a rigid, all-steel frame, electrically welded.

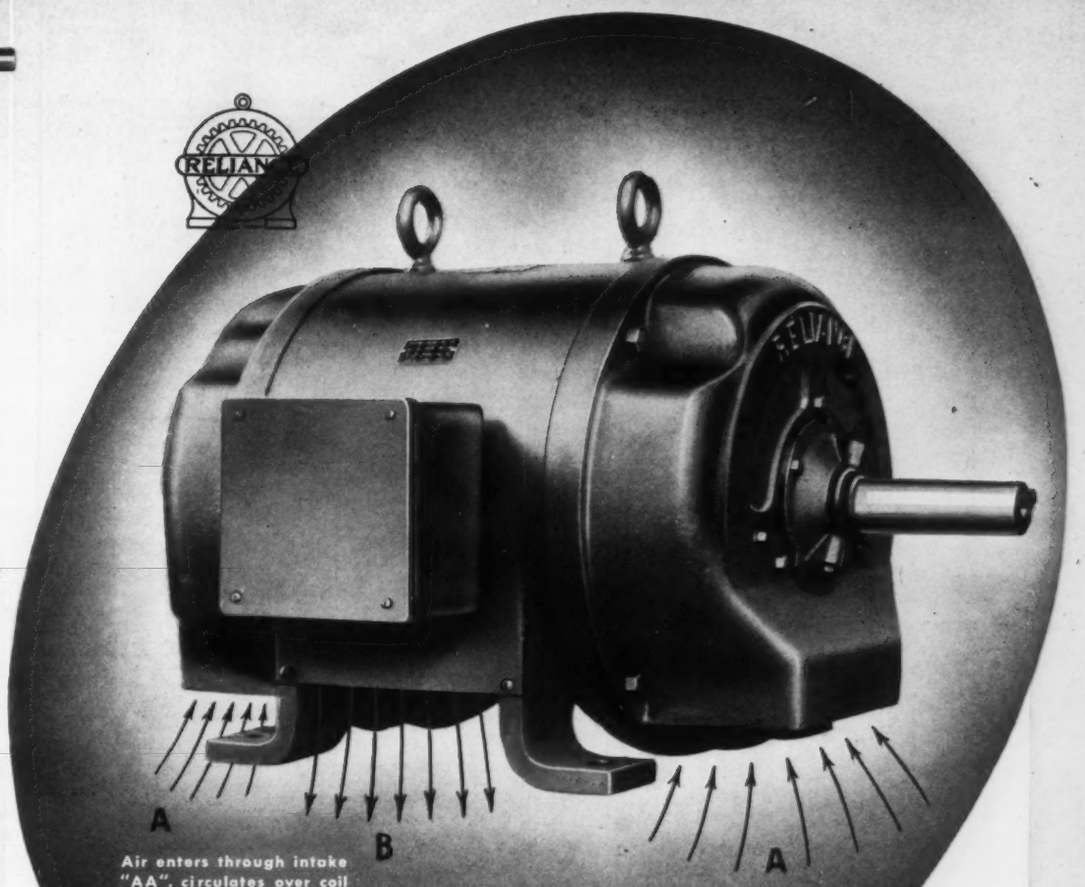


As an added safeguard, windings are protected by the Reliance Duraseal Insulation Process—a protective treatment based on thorough varnish impregnation and over-night bakings.

These splash-proof motors driving a cement mixer and conveyor on a construction job give the desired protection against dirt and moisture.



Splash-proof motors are useful on metal-working machines where protection is needed against flying chips and splashing coolant.



Air enters through intake "AA", circulates over coil heads and stator core, and leaves through opening "B"

SPLASH-PROOF TYPE "AA"

Reliance INDUCTION MOTOR

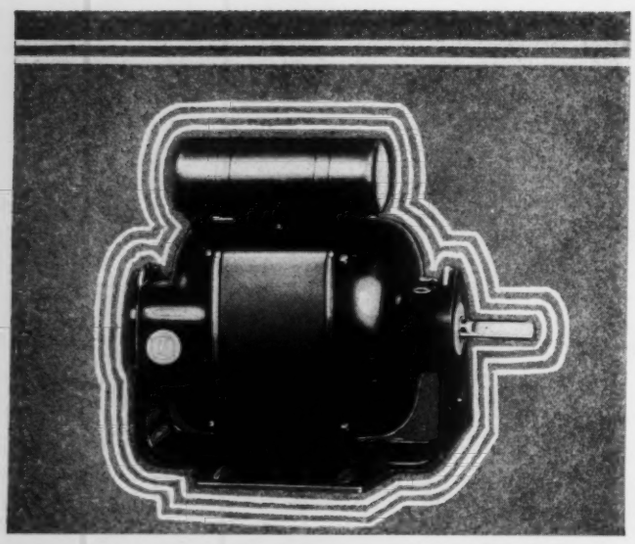
Splash, splash, splash! Drip, drip, drip! Neither splashing liquid nor dripping water has any terrors for Reliance Splash-proof Motors. Falling dirt and debris are likewise unable to get at the all-important windings. With the windings thus protected from attack, Reliance Splash-proof Motors have a better chance to attain a ripe old age. Ventilation is generously provided so that the same ratings are developed as in corresponding open frame sizes. Mounting dimensions are identical. The difference in weight is negligible. With all due credit to the medical profession, it is better not to need a doctor. Reliance's emphasis on "preventive maintenance" follows this principle. Our staff will be glad to help you nullify the threats we have mentioned.

THE RELIANCE ELECTRIC & ENGINEERING COMPANY
1068 IVANHOE ROAD CLEVELAND, OHIO

Branches: Boston, Buffalo, Chicago, Cincinnati, Detroit, Greenville (S. C.), New York, Philadelphia, Pittsburgh Representatives in other principal cities

Additional information on Reliance Splash-proof Type "AA" Motors will be found in our Bulletin No. 110

RELIANCE A-C D-C MOTORS



For sixteen years the Leland Electric Company has specialized on motors in the higher fractional and lower integral ratings.

They are familiar with the many and varied problems incident to the application of motors to appliances and machine shop equipment.

Consult Leland. Their experience in this particular branch of the motor designing industry should stand you in good stead.

THE LELAND ELECTRIC COMPANY
DAYTON, OHIO

Canadian Office
Toronto

Cable Address
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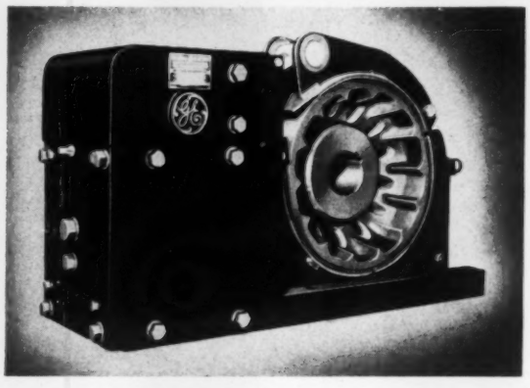
LELAND
DAYTON-TORONTO-PARIS-MILAN
MOTORS

NEW Materials and Parts

Brake Is Magnetically Operated

BRAKING is efficiently accomplished in a new three-shoe direct current magnetic brake brought out by the General Electric Co., Schenectady, N. Y. The mounting flexibility of the two-shoe brake with the braking surface protection of the band-type brake makes it admirably suited for steel mill machinery, cranes, hoists, conveyors and all places where it is necessary to stop and hold a load at the motor armature.

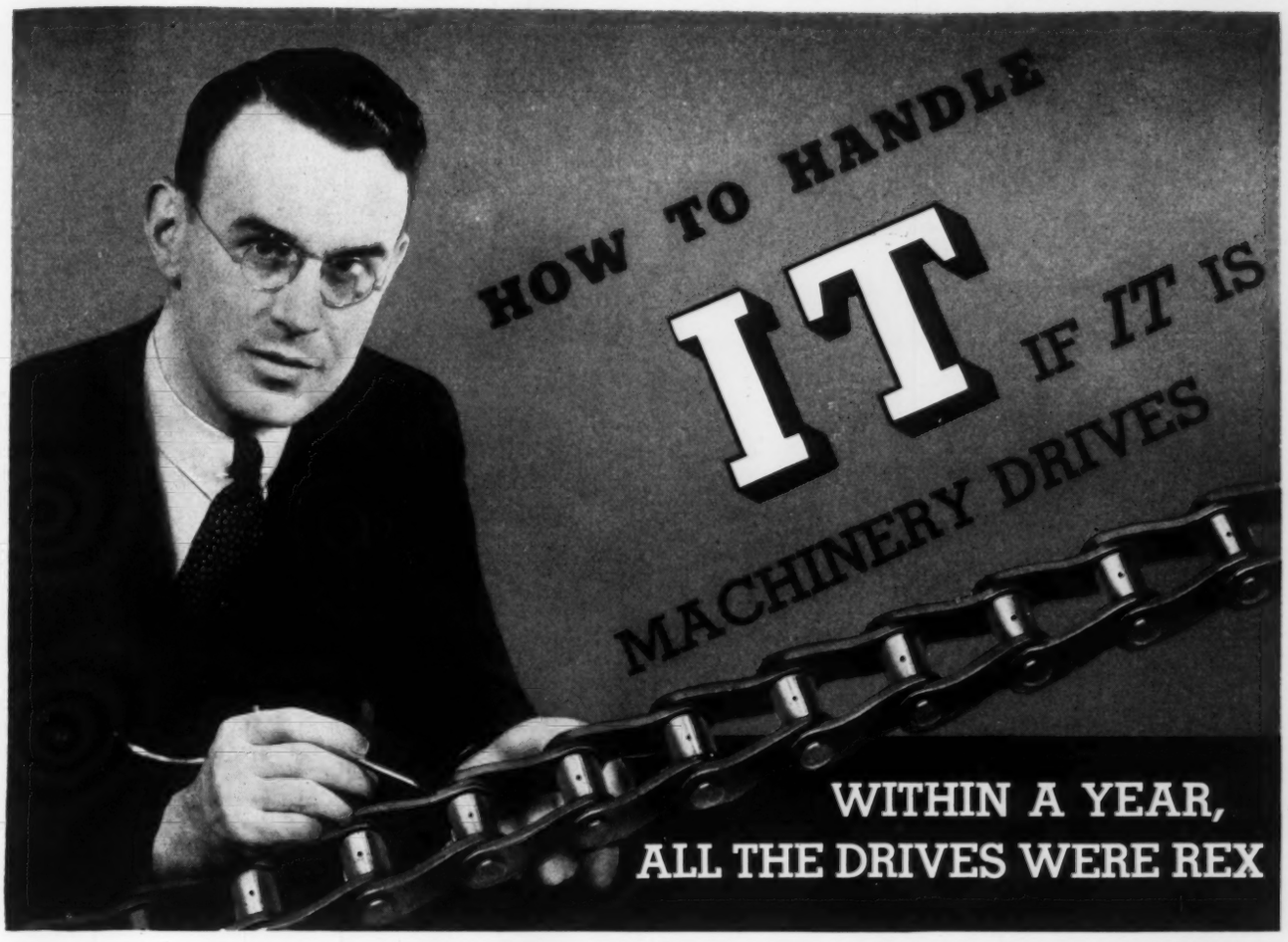
The peripheral length of the brake lining, over 85 per cent of the wheel periphery, is greater than that of either the conventional band or shoe-type brake. The protection against dust and dirt thus afforded greatly reduces wear on the wheel and lining. Braking in either direction of rotation is possible and smooth action is insured by a specially developed spring for brake setting which gives low build-up. The actuating mechanism uses a clapper-type magnet which is housed in a steel case lessening the accumulation of dust and dirt.



Three-shoe magnetically operated brake provides a maximum of brake shoe contact with extreme flexibility

Motorized Reducers Are Offered

ADDITION of a complete line of fractional horsepower motorized power gears to the standard line of reduction gears has been announced by the Foote Bros. Gear and Machine Corp., Chicago. Incorporating automatic and positive lubrication, antifriction bearings, dust seals and facilities for a variety of



● A manufacturer took over a new line of portable machinery that was chain driven, but not by Rex Chain Drives.

Within a year, every machine had been redesigned for Rex Chain Drives. A new machine for the heaviest duty ever known in the field was added to the line. Its five heavy-duty drives are all Rex.

Rex Chabelco Steel Roller Chain is the leading chain in portable machinery drives today, because of Rex Chain Engineers. By study and experience, they have developed the skill needed in the application in design that means freedom from trouble in the field.

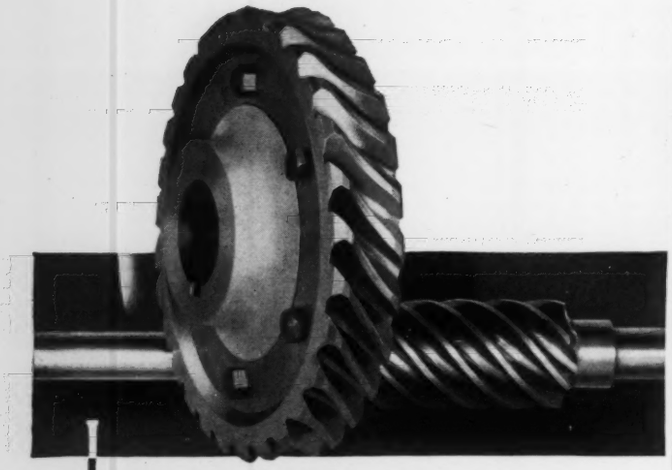
The services of Rex Chain Engineers are always available in working out with executives, designers and engineers any type of machinery drives. Send for these folders on Rex Drive Chains.

CHAIN BELT COMPANY
1643 W. Bruce St., Milwaukee, Wis.

REX

CHAIN BELT COMPANY
of MILWAUKEE

Drive and Conveyor Chains



INDUSTRY'S HERITAGE *from* MOTORDOM

• Industrial Engineers and Designers specify "Clevelands" for diversified and often difficult applications, because of this Company's notably successful record during a quarter-century.

"Cleveland" was organized in 1912 to build worm gears for the pioneering automotive industry, where Cleveland Worm Gear Drives were used in comparatively large quantity for rear axles.

The Company also pioneered almost 20 years ago, by introducing the automotive type of worm gear to meet the growing demand for industrial speed reducers. For 25 years, "Cleveland" has remained largest in the industry manufacturing high precision worm gearing *exclusively.*

In recent times, the automotive industry has again become a great market—many hundreds of "Clevelands" drive conveyors, furnaces, machinery, foundry equipment, ventilating fans, assembly line feeders and more than 40 other kinds of its plant equipment.

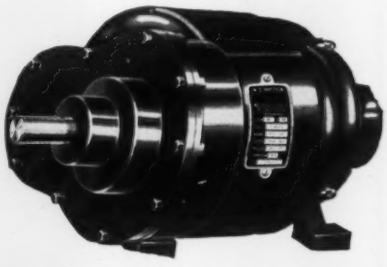
Whatever the nature of your own speed reducer applications, you doubtless will find sound help in consultation with a "Cleveland" Engineer. A representative from a nearby District Office will call at your convenience. The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication.

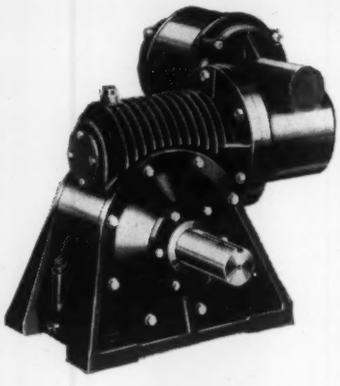
CLEVELAND *Worm Gear Drives*

mounting positions, the units are examples of well executed design.

On the left is a double reduction type reducer utilizing worm gears and cooling fins which can be supplied from ⅛ to 1½ horsepower. Speed ratios are from 96:1 to 8100:1. Helical gears are used on the single reduction unit on the right which is rated from ⅛ to 7½ horsepower with speed ratios of 2:1 to 8.77:1. All of the motorized reducers are finished in IXL standard blue-gray enamel, giving a durable as well as a distinctive finish.



Single reduction is accomplished by this unit with helical gears



Cooling fins and worm gears feature this unit which is rated from ⅛ to 1½ horsepower

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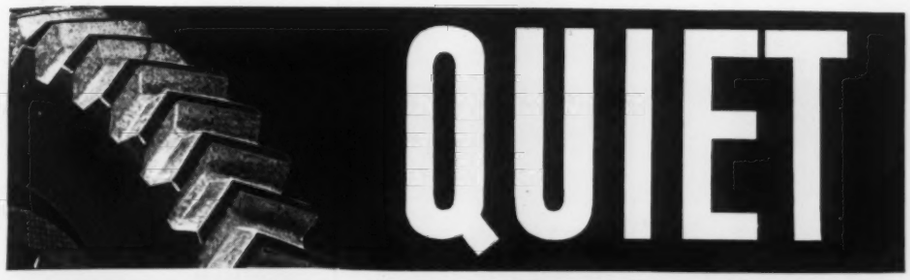
Heat Operates Overload Switch

A THERMAL overload switch for fractional horsepower motors which automatically disconnects the motor from the line when an overload occurs has been placed on the market by the General Electric Co., Schenectady, N. Y. It is designed to operate on line current and arranged for convenient mounting on the conduit or terminal box of the motor.

Bimetallic helix actuates the spring switch in this thermal controlled overload switch

Known as the "thermo-tector" the device reconnects



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QUIET machinery pays both the maker and the user. The maker finds such machinery easier to sell, increases his volume, decreases his selling expense. The user finds that it is easier on his men and results in fewer mistakes, less wasted material, and less labor turn over. Formica gears are used for replacement of metal gears on machinery that is already in use and for original equipment on new machinery. Replacement gears, as well as new gears in quantity, can be had promptly from the gear cutters named.

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Chicago Rawhide Mfg. Co.
Chicago, Ill.

Perfection Gear Company
Chicago, Ill.

Gear Specialties, Inc.
Chicago, Ill.

Merkle-Korff Gear Co.
Chicago, Ill.

Chicago Gear Works
Chicago, Ill.

Foote Gear Works
Cicero, Ill.

The Cincinnati Gear Co.
Cincinnati, O.

Clarksville Foundry & Machine Co.
Clarksville, Tenn.

The Horsburgh & Scott Co.
Cleveland, O.

The Stahl Gear & Machine Co.
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The Master Electric Co.
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The Adams Company
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Hartford Special Machinery Co.
Hartford, Conn.

Beaty Machine Works
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The Generating Gear Co.
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Badger State Gear Co.
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Precision Machine Co.
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Prager, Inc.
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J. Morrison Gilmour
New York City

Sier-Bath, Inc.
New York City, N. Y.

Mid-State Electrical Engineering Co.
Osceola Mills, Pa.

E. M. Smith Machine Co.
Peoria, Ill.

The Eagle Gear & Mch. Co.
Philadelphia, Pa.

The Pittsburgh Machine & Supply Co., Pittsburgh, Pa.

Perkins Machine & Gear Co.
Springfield, Mass.

Winfield H. Smith, Inc.
Springville, N. Y.

Alling Lander Company
Sodus, N. Y.

Charles E. Crofoot Gear Corp'n.
South Easton, Mass.

Arlington Machine Co.
St. Paul, Minn.

Farwell Mfg. Co.
Toledo, Ohio

Diefendorf Gear Corp.
Syracuse, N. Y.

Worcester Gear Works
Worcester, Mass.

Massachusetts Gear & Tool Co.
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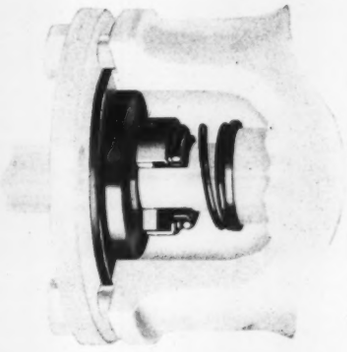
BALDOR
A BETTER MOTOR

the motor to the line when it has cooled, the entire operation being repeated at a safe interval until the motor is freed of the overload. The switch consists of a thermostatic bimetallic helix, a heater element, a flat spring and a contact arm. A low resistance heater is connected in series with the motor winding and completely surrounds the bimetallic helix. Heating of the element effects the bimetallic helix which actuates the spring breaking the circuit. The switch is available in ratings for alternating current fractional horsepower motors having full-load currents from 1.3 to 10.5 amperes.

Increased Flexibility With Seal

EXTREME flexibility has been incorporated into the improved rotary seal, KF model, developed by the Rotary Seal Co., 809 West Madison street, Chicago. The shape of the composition friction ring, together with the new position of the spring provides a diaphragm



Diaphragm action of this rotary seal permits lateral shaft movement without leakage

action taking care of any lateral shaft movement, shaft deflection or wear at the radial seal face. The newly designed seal is particularly suited for the shaft seal on compressors, pumps, gearcases or any high speed shafts. As in the standard models the entire KF model rotary seal turns with the shaft thereby eliminating friction and the resulting wear on the shaft surface. Different materials are used in the seal for various applications depending upon the substance to be sealed.

Pump Indicates Oil Cycle

DESIGNED for remote lubrication of machinery an improved pump brought out by the Trabon Engineering Corp., 1814 East 40 street, Cleveland, will indicate when each lubricating cycle has been completed assuring sufficient oil to moving parts. The single pipe line circuit is completely closed for manual operation at the pump and a broken line will prevent completion of the circuit which would fail to trip an indicator on the side of the pump, thereby warning the operator.

The pump is a horizontal double-ended piston type

HAS YOUR PRODUCT A GOOD *Business Head?*

Some products—such as elevators, trucks, tractors, machine tools, bank vaults, business machines, presses—can count, make records of their performance. Some—like amusement machines—have such good memories that they never forget a coin. Still others—like gasoline pumps—can even calculate . . . compute figures in dollars and cents.

The mechanical brains that give these products special advantages—allow them to *sell themselves*—are built-in Veeder-Root counting devices. These counters can record operations, starts, stops, pieces, trips, mileage, volume, speeds, lengths—provide accurate, fair methods of measuring work and wages.

Investigate Veeder-Root counting devices for *your* product. Veeder-Root engineers will be glad to work with you, in strictest confidence. *Write.*

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HARTFORD, CONNECTICUT, U. S. A.

Offices in Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Can., Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne.

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NEVER CRACKS NOR
GROWS BRITTLE—
STAYS WHITE ALWAYS—
HAS NO UNPLEASANT ODOR

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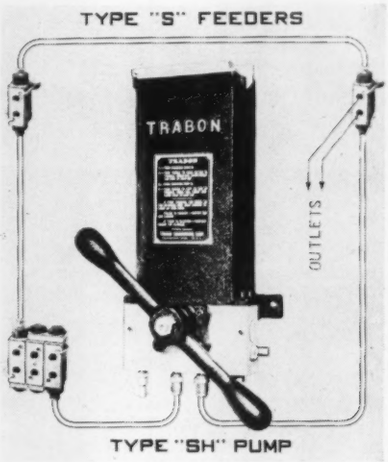
driven by the handle in front through a rack and pinion. Flow of lubricant is alternated first in one direction and then in another. Feeders are made in one body size and are available in four discharge capacities including a single outlet or twin outlet for two bearings. Each feeder is provided with a main metering piston

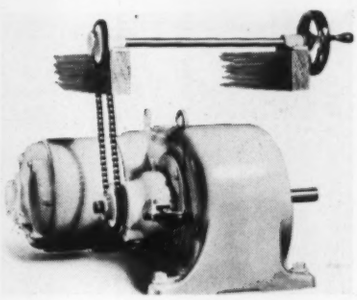


Closed pipe line circuit assures adequate lubrication with this oiler and indicates clogging or broken line

for determining a definite and positive volume. Lubricant entering either end first moves a valve piston to admit lubricant to the main chamber, and discharges a measured quantity to the bearing from the chamber. The flow then actuates another valve piston and passes on through the circuit to the next feeder. A blocked line or clogged bearing is indicated to the operator by his inability to complete the pump stroke.

Remote Control Operates Drive

REMOTE mechanical control of the U. S. variable drive motor has been insured with a line of standardized parts including bearing supports, shafting,



Accurate remote control is assured with the chain and sprocket type linkage used with this variable speed unit

sprockets and chains developed recently by the U. S. Electrical Motors, Inc., Los Angeles. The speed control is positive as the chain and sprocket type of linkage allows no slippage. Parts are made so that they may be conveniently and economically mounted on wood or metal supports. A few turns of a small handwheel

Maximum anti-friction performance is assured by the exclusive concave roller design of Shafer Bearings which combines:

1—Full roller bearing capacity for radial, or thrust, or combined radial-thrust loads.

2—Integral self-alignment.

3—Simple adjustability. The bearing action is unchanged by misalignment.

Shafer Bearing Corporation

35 East Wacker Drive, Chicago

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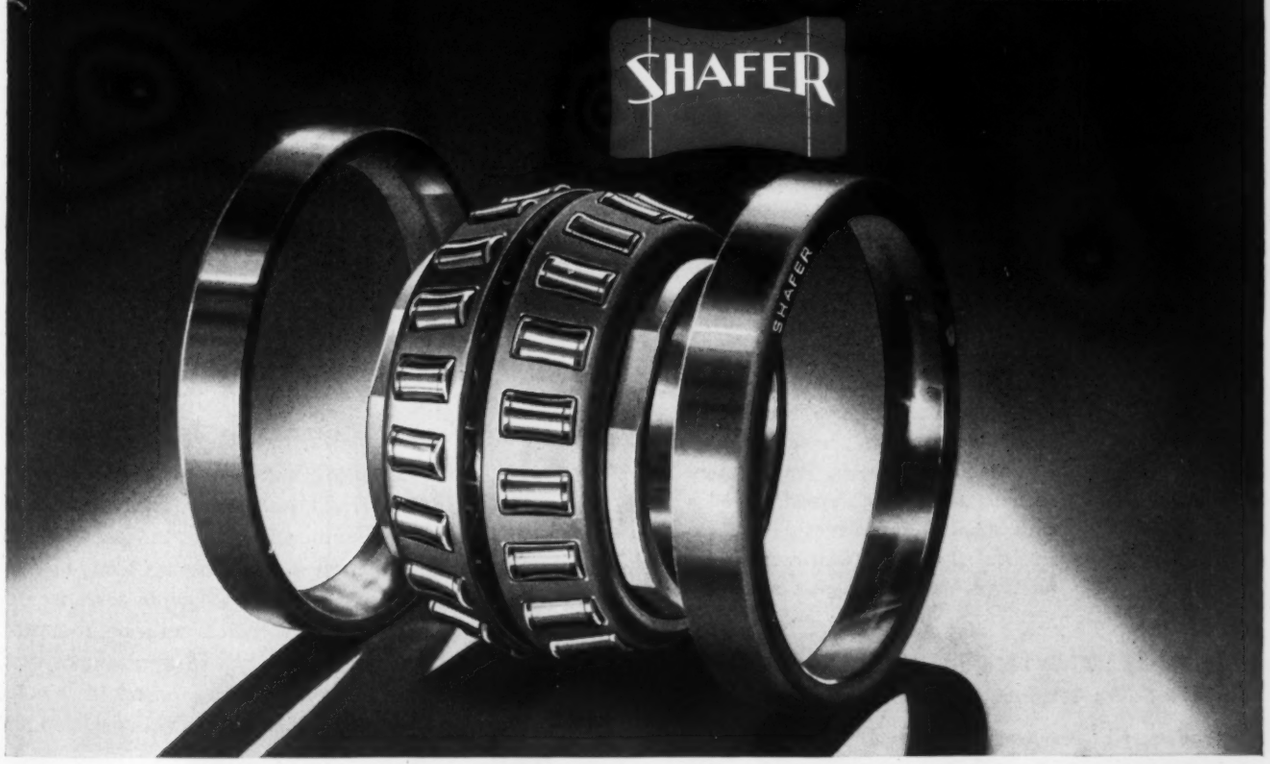
CONVEYOR ROLLS • RADIAL-THRUST ROLLER BEARINGS



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Ideal for built-in applications on production machinery

● Production Instrument Type SMC-1 mechanical counter, and Type SEC-1 electrical counter are new small-size counters especially designed for economical use on production machines. Exclusive features of construction provide positive action, large legible figures, and five wheel capacity to 99,999, in a dependable counter of unusually small overall dimensions.

The design of these counters provides positive movement of counting wheels, which with the large legible figures, avoids confusion in reading totals. A short lever throw (½ inch) in the mechanical counter, is combined with positive action which prevents skips or overthrow of number wheels. Simple rugged construction permits high speed operation with accurate, dependable recording. These new mechanical and electrical counters are non-reset type. Write for complete data and prices.

Type SMC-1 Mechanical Stroke Counter, size 1⅞ x 1½ x 1¾ in. Operating arm either right or left side of case. Five number wheels. Also Type SMC-2 with spring return, and Type SEC-1 Electric Counter for 6 volt service.

☆

PRODUCTION INSTRUMENT COMPANY
1319 South Wabash Avenue, Chicago, Illinois

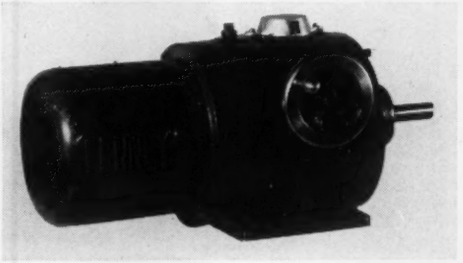
Manufacturers of Precision Counting and Recording Devices and Sensitive Switches

by the operator gives the entire speed range of the variable drive motor.

Variable Speed Unit Is Quiet

QUIETNESS and freedom from vibration are outstanding features of a new variable speed transmission introduced recently by the Lenney Machine & Manufacturing Co., Warren, O. Absence of reciprocating parts is responsible for the smooth running of the unit. Variable speed is accomplished by a hardened steel driving disk in pressure contact with a hardened steel roller. An automatic loading device is part of the driving disk which insures that the contact pressure between the disk and the roller be in proportion to the load.

The unit is designed so that it may run in either direction and the speed at which it is set to run will not vary, no matter what the imposed load on the output shaft, according to the makers. Speed can be changed at any time, either while running or at rest, and a dial on the top of the unit makes easy setting of predetermined speeds. Ease of installation is obtained in the transmission as both the input and output shaft are in line. Ball bearings are used extensively in its construction and a bath of oil in which the parts operate insures long life and freedom from wear. Sizes are from ⅛ to 5 horsepower.



Absence of reciprocating parts makes this variable speed unit practically free from vibration

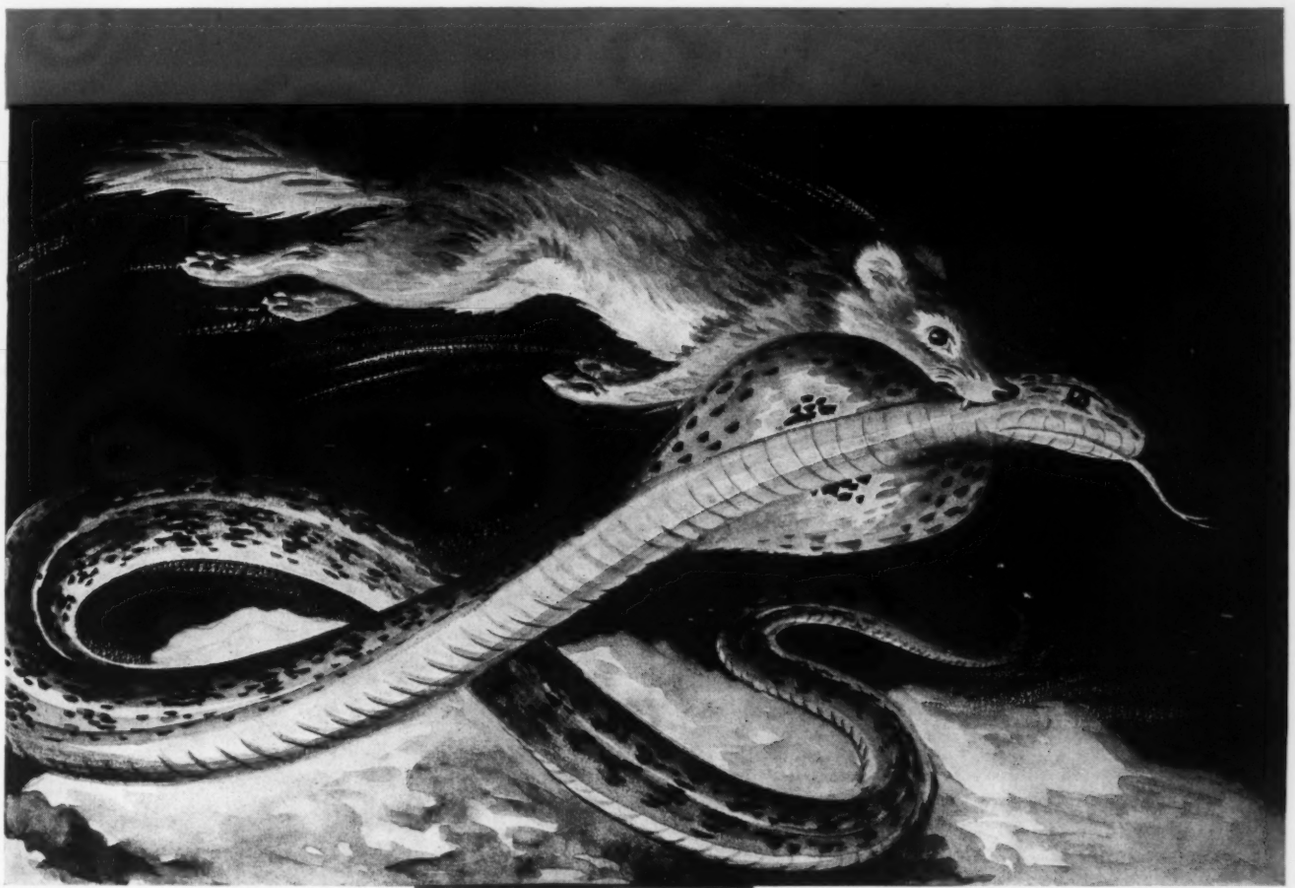
---

Pillow Block Mounting Is Universal

MOUNTING of pillow blocks in any position has been facilitated by an improved universal position model recently announced by the Randall Graphite Products Corp., 609 West Lake street, Chicago. With this model it is not necessary to know in advance the position in which the pillow block will be mounted. Holes are provided for the oil cup in several positions and it is only necessary once the mounting is selected to unscrew the oil cup, turn the ball to this position and reinsert the oil cup vertically.

Like other Randall Graphite pillow blocks this new

A *FIGHT* TO THE FINISH!



In a fight between the Mongoose and the giant King Cobra there is no compromise. One of them must die.

Only a helical Spring Washer has adequate range of Live Action to win against wear and looseness

There can be no half-way measures in keeping a bolted assembly *tight.* When inevitable wear has developed, play and looseness follow unless compensated for by the *Live Action* of a *helical* SpringWasher. Every correctly designed bolted assembly *must* include a *helical* Spring Washer of adequate *range* and *power.*

SPRING WASHER INDUSTRY

618 WRIGLEY BUILDING • CHICAGO, ILL.

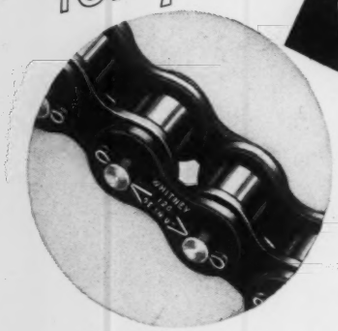
ONLY A *helical* SPRING WASHER HAS ADEQUATE *Live Action*

WHITNEY CHAIN

there is no substitute for performance

Roller Chains

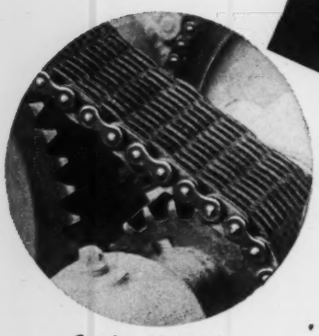
Whitney Roller Chain Drives are one of the most versatile machine units for the transmission of power. Positive, flexible and easily adapted to special requirements.



Catalog V-115A

Silent Chains

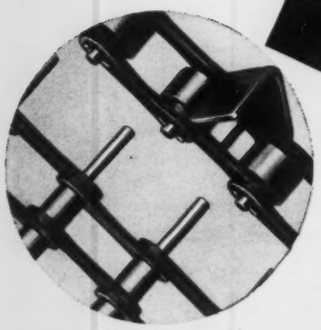
Whitney Silent Chain Drives are recognized as outstanding in performance. They offer smooth dependable power transmission, quiet operation and unusual resistance to wear.



Catalog V-112A

Conveyor Chains

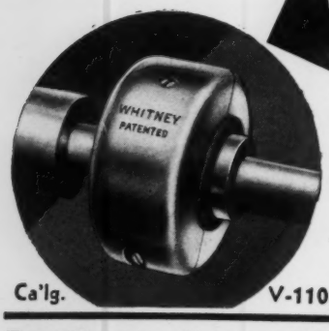
Whitney Conveyor Chains are easily adapted to special requirements through the use of standard or special attachments. They improve and simplify conveyor design.



Catalog V-116A

Flexible Couplings

Whitney Roller Chain Flexible Couplings can be easily assembled or disassembled. The patented coupling cover provided adequate lubrication and finished appearance.

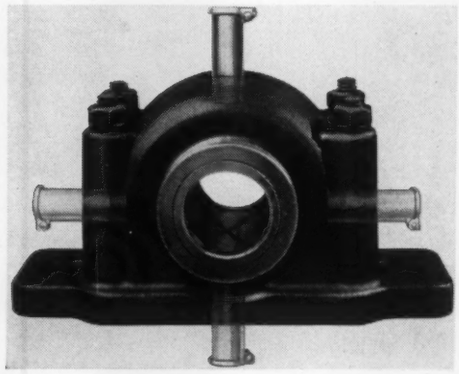


Ca'lg. V-110A

Dept. B-3

THE WHITNEY CHAIN & MFG. CO. HARTFORD, CONN.

model has two large reservoirs in the spherical ball. A supply of oil is placed in the upper one which feeds the shaft as needed through graphite feed plugs. Oil re-

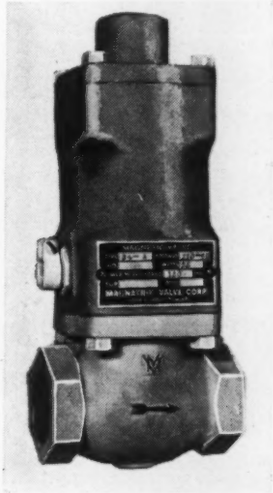


Two large oil reservoirs in the spherical ball of this pillow block insure adequate lubrication

covery grooves divert unconsumed oil into the lower wool-packed reservoir where it is again fed to the bearing through lower graphite feed plugs. According to the manufacturers, the universal position pillow block holds three times the amount of oil as standard types.

Valve Is Magnetically Controlled

SUITED for high pressure steam, gas, oil or other uses an improved magnetically controlled valve has recently been placed on the market by the Magnatrol



Asbestos around the electrical coils of this valve insure protection from high temperatures

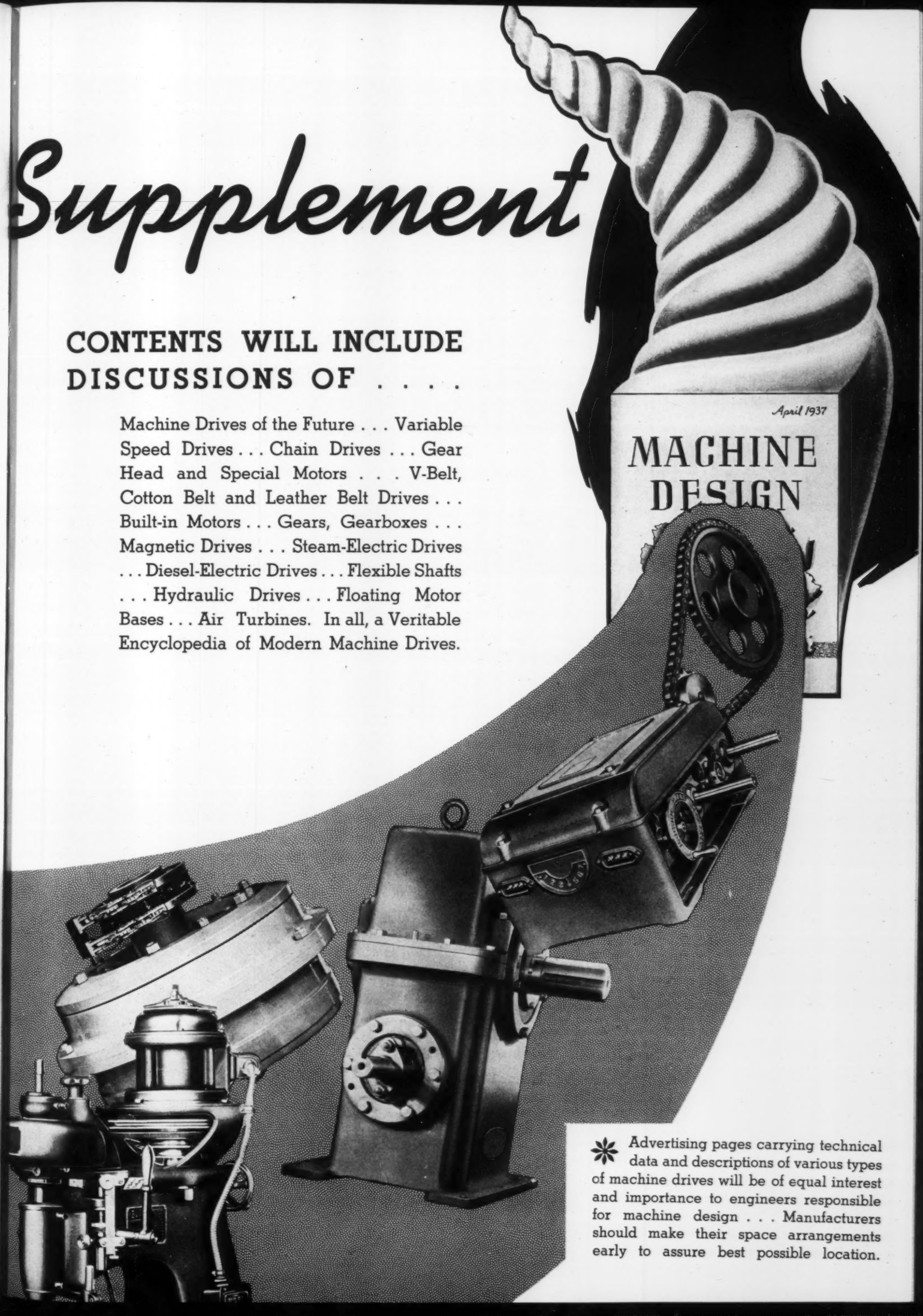
Valve Corp., 52 Beekman street, New York City. Because of its sturdy construction the valve is particularly applicable to machinery where jarring or vibration might be encountered. The solenoid coils which actuate the piston are asbestos insulated and impervious to high

(*Continued on Page* 82)

Supplement

CONTENTS WILL INCLUDE DISCUSSIONS OF . . . .

Machine Drives of the Future . . . Variable Speed Drives . . . Chain Drives . . . Gear Head and Special Motors . . . V-Belt, Cotton Belt and Leather Belt Drives . . . Built-in Motors . . . Gears, Gearboxes . . . Magnetic Drives . . . Steam-Electric Drives . . . Diesel-Electric Drives . . . Flexible Shafts . . . Hydraulic Drives . . . Floating Motor Bases . . . Air Turbines. In all, a Veritable Encyclopedia of Modern Machine Drives.



✱ Advertising pages carrying technical data and descriptions of various types of machine drives will be of equal interest and importance to engineers responsible for machine design . . . Manufacturers should make their space arrangements early to assure best possible location.

SPEED REDUCERS

Motorized vertical helical reducer 4143-MV

Motorized double worm gear variable speed reducer 7-28-D

the above are among the many installations made by the Foote Gear Works Inc., and now doing service satisfactorily in plants throughout the country.

The vertical helical is one of 32 units installed to drive agitators in 126 foot diameter digester tank ½ H.P. motor—1200 RPM—ratio 80½ to 1. Installation made in southwest sewage disposal plant, Chicago Sanitary District.

128 page data book FREE

send for your copy to

FOOTE GEAR WORKS, INC.

Cut Gears Of All Kinds.

1301-G. S. Cicero Av., Cicero, Ill.

Back Up Your Ideas with Knowledge

When you present your "pet idea" to the boss—be sure you can answer his arguments intelligently. For there lies opportunity. And here is your opportunity to become a leader in the field of your own specialization.

Our home study course on the "Theory and Technique of Inventive Practice" has been revised, greatly enlarged, and improved by the incorporation of results from past experience and teaching. It is modern in methods of instruction and the terms have been made easy for you.

We are ready to help you toward your life's ambition, "NOW IT IS UP TO YOU." Write today for your copy of our new illustrated catalog.

TROFIMOV SCHOOL OF INVENTIVE PRACTICE, INC.
3859 Northampton Rd., Cleveland Heights, Ohio
Please send me, without obligation, your catalog "4-13."

Name.....

Address.....

City..... State.....

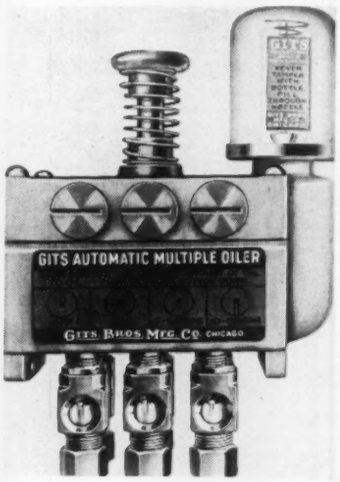
(*Continued from Page* 78)

temperatures. It is used with temperatures up to 400 degrees Fahr. The pilot needle and stem are of stainless steel while the piston and globe valve body are of bronze. Closing of the electrical circuit causes the valve to open and breaking of the circuit closes it. The valves are supplied in sizes ranging from ½ to two-inch pipe size.

Multiple Oiler Simplifies Lubrication

SIMPLIFICATION of machine lubrication is possible with a new automatic multiple oiler brought out by the Gits Bros. Mfg. Co., 1846 South Kilbourn avenue, Chicago. The oiler is especially designed for high speed production machinery where frequent oiling is necessary. A hand-operated plunger releases oil to from two to 16 leads depending upon the size of oiler. Adjustment

Complete lubrication is easily accomplished in this multiple oiler by a single movement of the plunger



screws, one for each lead, are placed on each side of the box and can be set to give from one to ten drops of oil.

An unbreakable bayonet type constant level reservoir is placed at one end of the oiler where it is easy for the oil level to be discerned. Unbreakable sight feed glass is installed on the oil leads to show the oil that is actually draining to the parts. The body is made of aluminum and compactly designed. Lugs are cast integrally with the body to provide mountings.

Coupling Provides For Flexibility

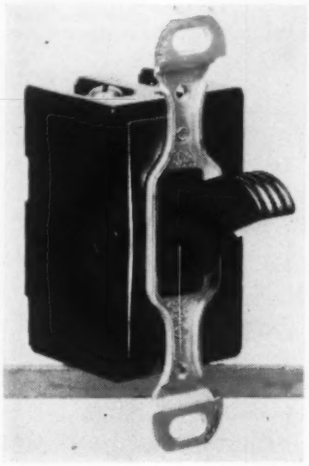
GREATER flexibility over the ordinary jaw coupling has been built into a new model recently announced by the Boston Gear Works Inc., North Quincy, Mass. It is a three-jawed coupling equipped with insert having hardened and ground balls, similar to those used in ball bearings, which are in contact with hardened and ground jaw surfaces to carry the load. The greater flexibility of this coupling over the conventional

type jaw coupling removes the strain between motor and machine, permitting unrestricted end play of motor shaft. Holes and hub are soft, which permits alterations to be made in the size of the bore.

Coupling is flexible because of hardened balls carried in insert cage

Switch Is Slow Breaking

UTILIZING the method of slow breaking heavy silver contacts for circuit breaking, Hart Mfg. Co., Hartford, Conn., has brought out a small toggle switch made for alternating current only. It is especially adapted for use with heavy duty appliances, equipment using fractional horsepower motors and special lighting circuits. Positive action and perfect contact are claimed by the makers and the slow breaking principle assures long life to the switch under severe operating conditions. The case and toggle are of molded Bakelite and the switch is made for flush, exterior or interior mounting. It is 2 11/32 inches long and 1⅜ inches wide.



Molded Bakelite is used for the case and toggle of this switch which is made for flush, interior or exterior mountings

Welding of White Metal Is Possible

WELDING of white metal used for die castings and considered as unweldable is now said to be satisfactorily accomplished by a new patented process employing a special rod manufactured by the Aladdin Rod & Flux Co., P. O. Box 935, Grand Rapids, Mich. The rod is claimed to make a weld that has as great strength as the base material and therefore does not require

MAKING
"SELLING DREAMS"
COME TRUE

IMAGINARY INTERVIEWS
1. Salesman and Machine Designer

"The time has come," the salesman sighed,
"To speak of many things—
Of why swell orders fly away
On competition's wings,
And of the sales advantages*
A well-known motor brings."

"I weep with you," the other sobbed,
"I share your every woe,
Because unless you sell our stuff
My kids don't eat. And so
You'll find that I'll do anything
To help your orders grow."

"The jobs I've lost!" the salesman moaned.
"I think my heart will break—
And all because the motors were
A nonfamiliar make!
If we had motors that they knew,
My sales would take the cake!"

MORAL

So they agreed, right then and there,
Without a great to-do
To use but G-E motors till
Their selling dreams come true.

* * * *

This choice has made them money and
'Twill do the same for you!

*Machinery buyers have a preference for G-E equipment, as proved by a recent impartial survey made by a leading publisher. About 10,000 motor buyers were asked: "When you are next in the market for motors and control, which manufacturers will you ask for quotations?" General Electric was included by 8200 buyers. It was FIRST CHOICE with 5300, as compared with 1950 for the manufacturer that ranked second. General Electric, Schenectady, N. Y.

011-181

GENERAL ELECTRIC

The ROTATING-CAM SWITCH Designed for the Machine Designer

FOR USE AS

Full-voltage Reversing Switch for Squirrel-cage Motors
Two-speed Control for Single-winding A-c Motors
Two-speed Control for Separate-winding A-c Motors
Three- or Four-speed Control With One Reverse Speed

MACHINE designers will especially appreciate this switch. With the flange, which is available for flush mounting of the standard switch, all that the designer needs to provide for completely *built-in* control is an opening and drilling in the face of the machine.

The safety advantages of this switch are obvious. Since it is completely enclosed in a steel housing, even when mounted entirely within a machine, the operator is safeguarded, and the possibility of failure due to accumulations of dirt on the switch is minimized.

Another advantage of this universally adaptable switch is the fact that a stock of only a few standard models makes it easy to meet almost any machine requirement—by the use of the flush-mounting flanges and the five types of operating knobs or levers.

We shall be glad to send you complete descriptive information, with dimensions and application data. Write for Publication GEA-2230. General Electric, Schenectady, N. Y.

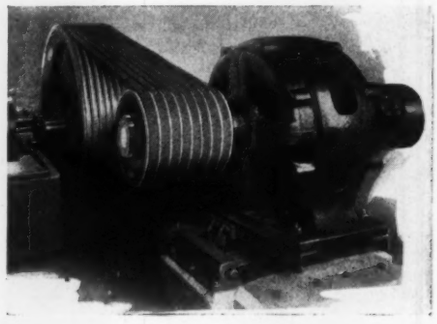
080-99

GENERAL ELECTRIC

reinforcing except where improper design is at fault. The pieces to be welded are prepared by grinding off the surfaces in conventional fashion, then applying an oxyacetylene flame until the metal assumes a liquid appearance at which time the Aladdin rod is applied.

Pivoted Base Insures Belt Tension

CORRECT belt tension is assured with a pivoted motor base recently announced by the Rockwood Mfg. Co., Indianapolis, Ind., which is applicable to many types of machine. It is especially designed for use with V-belts where constant tension prevents slippage and undue wear of the belts. The motor is so pivoted with the use of the Rockwood base that its weight keeps a constant tension on the drive. By this means belt stretch is automatically taken up.



Belt tension is held with a minimum of working parts with pivoted base

---

Lamp Withstands Shock

CONCENTRATED light is assured in a sturdy lamp designed especially for installations on tables or benches subject to excessive vibration which has been added to the line of lighting equipment of Fostoria Pressed Steel Corp., Fostoria, O. The new Unifocal model is equipped with a ball and socket joint at the reflector, a spring friction joint at the top of the base and has an overall length of 33 inches.

Light is sharply focused by the special aluminum spun reflector of this lamp

MEETINGS *and* EXPOSITIONS

Feb. 14-19—

National Electrical Manufacturers association. Mid-winter meeting to be held at Waldorf-Astoria hotel, New York. W. J. Donald, 155 East Forty-fourth street, New York, is managing director.

Feb. 15-18—

American Institute of Mining and Metallurgical Engineers. 147th annual meeting to be held at Engineering Societies building, New York. A. B. Parsons, 29 West Thirty-ninth street, New York, is secretary.

Feb. 22-25—

Technical Association of the Pulp and Paper Industry. Annual meeting to be held at Waldorf-Astoria hotel, New York. R. G. MacDonald, 122 East Forty-second street, New York, is secretary.

Feb. 28—Mar. 19—

Leipzig Trade Fair. To be held in Leipzig, Germany. American headquarters at 10 East Fortieth street, New York.

Mar. 3—

American Society for Testing Materials. Regional meeting to be held at Palmer House, Chicago. C. L. Warwick, 260 South Broad street, Philadelphia, is secretary.

Mar. 3-4—

Electrodepositors' Technical Society. First international electrodeposition conference to be held at British Industries House, London. H. Wynne-Williams, 12A, Raleigh House, Larkhall Estate, London, S.W. 8, is honorary secretary.

Mar. 10-12—

Institute of Radio Engineers. Annual meeting and exhibit to be held in New York. Harold P. Westman, 330 West Forty-second street, New York, is secretary.

Mar. 15-19—

National Oil Burner and Air Conditioning Exposition and Convention. To be held at Convention hall of the Commercial Museum, Philadelphia. Additional information can be obtained from N. W. Ayer & Son, Inc., Washington Square, Philadelphia.

WHICH MOTOR for Your Product?

DON'T let the "Which Motor?" problem puzzle you when you are selecting the drive for your product.

By investigating the problem from every angle with the help of General Electric's experienced motor engineers, you can determine the type of motor that will exactly meet the requirements of both your machine and of the conditions under which it is to operate. By selecting the *right* motor from the *complete* G-E line, you can obtain the motor that will give your customers the most dependable service at the lowest cost.

It will pay you to look for more than just a motor that will make your machine run. Your customers will be pleased with the economies made possible by a G-E motor which they know has been selected to fit exactly your machine and the operating conditions in their plants.

Take advantage of the services of General Electric in solving your drive problems. Build an increased preference for your products—equip them with G-E motors. General Electric, Schenectady, N.Y.

020-307

GENERAL ELECTRIC

WHEN TIME SAVES MONEY

YOU PROFIT

CONTROL of timing helps you save your customer money. It reduces spoilage, reduces waste, and leads to better products and more efficient workmen. All these are economies in which he, and you, are interested.

You can give him these economies and profit yourself by putting G-E time switches on your machines. This accurate, automatic control offers you additional selling points and greater opportunities for sales. Every time it saves your customer money, you profit.

Here are examples of its use:

Hydraulic presses
Tire molds
Plastics molds
Heat-treating equipment
Many other curing processes
Carpet driers
Photographic printing machines
Laundry-type washing machine
Fire-pump control
Paint mixers
Cement mixers
Asphalt mixers
Dough and other batch mixers
Violet-ray apparatus
Safes, cash boxes, cash drawers, and other money-protective devices
Conveyor-load signaling

Would you like to know how a G-E time switch can help your machine? Write to your nearest G-E sales office, or Dept. 6B-201, General Electric, Schenectady, N. Y.

440-108

GENERAL ELECTRIC

MANUFACTURERS' PUBLICATIONS

ALLOYS (COPPER)—Detailed information on the properties, heat treatment, fabrication and application of beryllium copper is given in a folder being distributed by Beryllium Corporation of Pennsylvania, Reading, Pa.

BEARINGS—Six types of pillow blocks, including a new universal-position model, are covered in the new 1937 catalog recently issued by Randall Graphite Products Corp., 609 West Lake street, Chicago. Also included are descriptions of oil cups, bronze safety collars and fiber washers, and insulated rubber mountings.

CHAINS—Publication of three descriptive bulletins covering Rex roller chain, Rex griplock chain and Rex Z-metal chain respectively has been announced by Chain Belt Co., Milwaukee. Illustrations and data regarding the physical properties, applications, and the type and size available of each kind of chain are given.

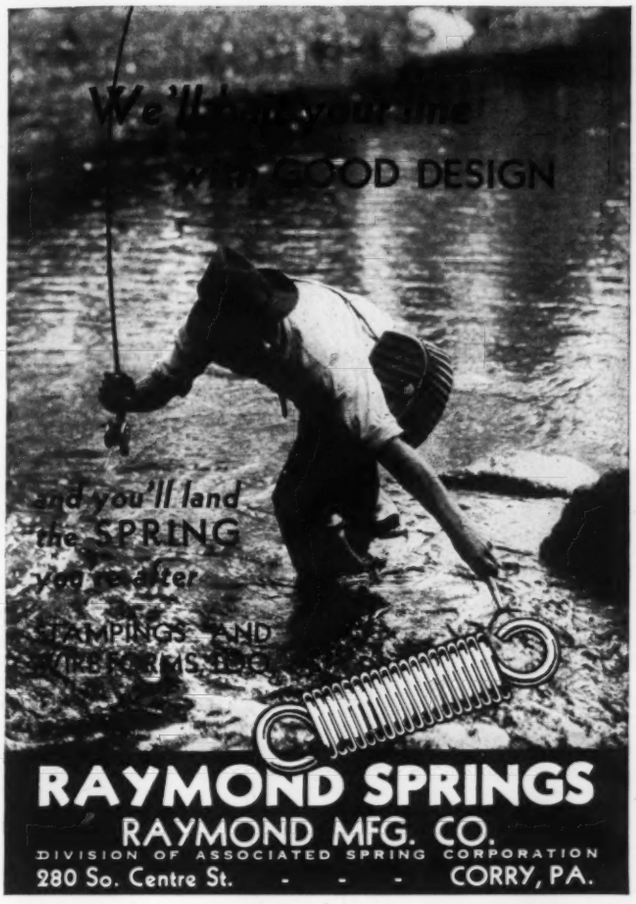
CONTROLS (ELECTRICAL)—Technical and descriptive data covering the light-sensitive cell has been published in a folder recently issued by General Electric Co., Schenectady, N. Y. Detailed descriptive information is given on the construction, performance and application of the cell, while curves show its various characteristics, such as current against illumination and temperature, and voltage against light and temperature.

CONTROLS (ELECTRICAL) — Distinctive features and characteristics of type ICT temperature relays, used to protect alternating-current machines and transformers against overheating due to continued excessive load, are discussed in a recent release of General Electric Co., Schenectady, N. Y.

COUPLINGS—Bulletin V-110 A, issued by Whitney Chain & Mfg. Co., Hartford, Conn., describes the company's line of roller chain flexible couplings, including detailed tables giving service factors, standard bore tolerances, standard keyways, coupling cover dimensions and list prices.

DRIVES—Applications of the Transitorq variable speed transmission are shown in the new bulletin issued by New Departure Mfg. Co., Bristol, Conn. Data regarding its features are also included.

DRIVES—In a recent catalog, prepared by Lenney Machine & Mfg. Co., Warren, O., features of a new variable speed transmission, principle of operation, ap-



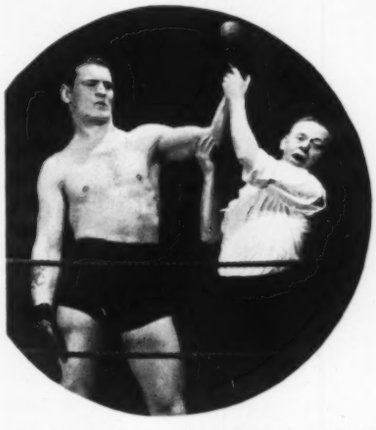
RAYMOND SPRINGS

RAYMOND MFG. CO.

DIVISION OF ASSOCIATED SPRING CORPORATION

280 So. Centre St. - - - CORRY, PA.

The Pump with the **PUNCH**



TO REACH THE DEEPEST BORES AND CUTS

Roper Coolant Pumps are made in practically all types needed for handling cutting compounds and lubricating fluids on metal working machines.

Engineered and built to give long efficient service at low cost.

One way or two way types.

Write for Bulletin R4MD

Geo. D. Roper Corp., Rockford, Ill., U.S.A.

ROPER PUMPS

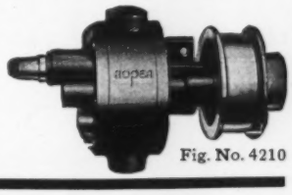


Fig. No. 4210

CHECK YOUR PROCESS FOR ELECTRIC HEAT

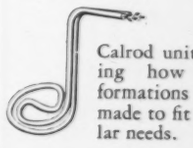
"SPOT"

Branding irons
Cellophane sealing machines
Cigarette machines
Clothes-pressing devices
Electric evaporators
Embossing machines
Harness-making machinery
Laundry machinery
Laboratory hydraulic presses
Line-casting machinery
Locomotive rail sanders
Optical tools
Package-wrapping machinery
Paper-box machines
Sanforizing machinery
Shoemaking machinery
Textile machinery
Wire and cable machinery

"Spot," the G-E cartridge heater, concentrates heat where needed, in just the quantity required. Self-contained, "Spots" eliminate steam and gas piping, and fumes in the workplace. Available in a multitude of sizes and ratings.

SPECIAL CALRODS

Air filters
Air-conditioning machinery
Branding irons
Can-soldering machines
Car-heating units
Chemical tanks and stills
Doughnut-making machines
Frankfurter cookers
Hydraulic presses
Labeling machinery
Laundry machinery
Line-casting machines
Matrix presses
Ovens
Paper-container machines
Paraffin heating
Paraffin-spraying machines
Plating tanks
Shoemaking machinery
Snow melters
Type-melting pots
Unit air heaters



Calrod unit, showing how special formations can be made to fit particular needs.

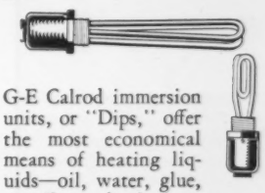
"STRIP"

Beer-vat dryers
Box-toe steamers
Dairy sterilizers
Fruit colorizers
Fruit conditioning
Incubators
Matrix scorchers
Plate whirlers
Preheating oil
Small ovens

G-E "Strips" are made with steel sheaths for operation at temperatures up to 750 F, and with chrome-steel sheaths for temperatures up to 1200 F. Unusual strength, coupled with ease of installation, recommends "Strip" for process machinery.

"DIP"

Airplane tenders
Brooders
Candy-coating machines
Coal-treating machines
Dairy sterilizing machinery
Egg sterilizers
Fruit sterilizers
Incubators
Industrial cleaning tanks
Oil-heating equipment
Oil purifiers
Paper-box machinery
Shoemaking machinery
Steam generators
Steam radiators
Stills and sterilizers
Vulcanizers



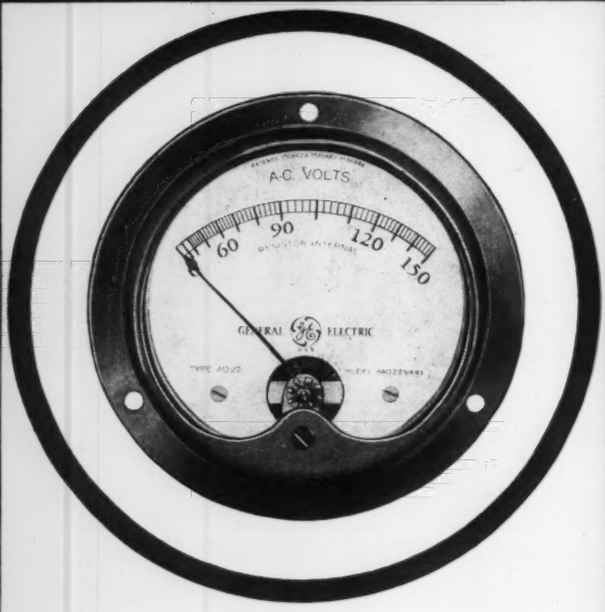
G-E Calrod immersion units, or "Dips," offer the most economical means of heating liquids—oil, water, glue, paraffin, and others.

Complete information on G-E heating units for process machinery is contained in our "mail-order catalog," GEA-1520B. Write for a copy. General Electric, Schenectady, N. Y.

160-52

GENERAL ELECTRIC

DESIGNED TO HELP YOU SELL



WITH these instruments on your machines, you will get that extra beauty that adds so much to the sales appeal. Each instrument is sleek and modern looking—to meet modern requirements. Each is designed to help you sell.

And the quality is in keeping with this clean-cut appearance. For not only are they attractive, but they're easy to read, sturdily built, and—more important—highly accurate. G-E reputation—a reputation that helps you sell—is behind each instrument.

Our engineers will be glad to adapt one of these designs to meet your requirements—or, if necessary, they will submit special designs to fit your product. Their skill is shown in dozens of designs on machines throughout the country. Make General Electric your headquarters for electric measurement.

For detailed information on the small instruments for built-in service, see Bulletin GEA-1239C. Address your nearest G-E sales office, or General Electric, Dept. 6A-201, Schenectady, N. Y.

430-93

GENERAL ELECTRIC

plication, speed regulation and speed control are discussed. When driven with a motor operating at 1150 revolutions per minute, this new motorized transmission gives an output speed of from 150 to 500 revolutions per minute.

FASTENINGS—A 38-page catalog, printed in two colors, covering tables of dimensions and weights, specifications, standards and illustrations of fibro-forged screws has been released by Holo-Krome Screw Corp., Hartford, Conn.

FINISHES—Parker Rust-Proof Co., 2177 East Milwaukee avenue, Detroit, in a recently issued catalog gives information on its Dip-Spra-Bonderizing process for rust proofing of metals. Descriptions cover the method of application and specifications for a Bonderite tank.

FORGINGS—Unusual forgings are described in an illustrated bulletin recently issued by Champion Machine & Forging Co., Cleveland. The various points considered in the selection of the steel; the forging, normalizing, annealing or heat treating of it; and the final inspection, are discussed at length in this 8-page bulletin.

GEARS—Foote Bros. Gear & Machine Corp., 5301 South Western boulevard, Chicago, has recently issued Bulletin No. 750 containing data on its line of IXL fractional horsepower powered gears for slow speed drives in helical, worm or combination type. The bulletin is illustrated profusely with photographs, tables, charts and cross sectional drawings of various types of gear units.

MOTORS—Century Electric Co., 1806 Pine street, St. Louis, is distributing a catalog on repulsion start, induction, brush-lifting, single-phase motors. These motors have the starting characteristics of the repulsion motor and the operating characteristics of the induction motor for use where high starting torque, low starting current and automatic starting are desirable.

PUMPS—A new pocket-size "Pump Data" handbook has been brought out by Economy Pumping Machinery Co., 3431 West Forty-eighth place, Chicago, to aid the designer, operator or prospective purchaser in the solution of pumping problems. The first section of the book is devoted to various classes of pumps manufactured by the company, their prices, applications and installation; while the second part covers engineering data.

TESTING—Methods used in the plant of Reliance Electric & Engineering Co., 1088 Ivanhoe road, Cleveland, for the manufacture, testing and inspection of commutators for direct current generators and motors are given in a folder recently issued by the company.

OPEN TYPE

DESIGNED TO WITHSTAND

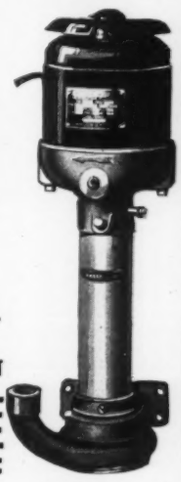
the destructive action of lapping compound when attached to grinding machines.

THE **BROWNIE Coolant Pump**

proves itself economically suited to any machine design.

Centrifugal in operation — the Brownie Pump is self aligning. Full rigidity of driving shaft is assured by the vital support of a ball bearing within one inch of the impeller.

Both drive shaft and impeller tube are one unit revolving together. There are no packings to leak and no screens to clog. Capacities 10-100 G.P.M.



TOMKINS-JOHNSON CO.
618 N. MECHANIC ST.
JACKSON MICHIGAN

CLOSED TYPE

PUT YOUR FINGER

ON THE CORRECT TYPE OF FELT . . .

Write for this chart!

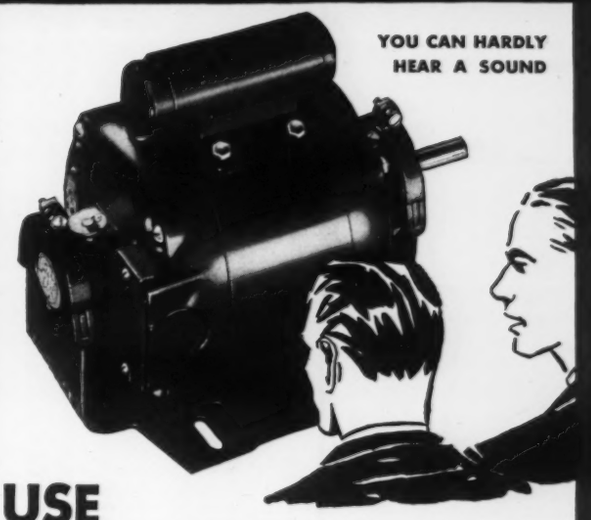
• IT CLASSIFIES the correct applications for the standard types of felt. Complete set of sample swatches. Standard file size. Devised as A HELP to you . . . not for sales follow-up. Mailed to any felt user.

BOOTH FELT COMPANY, INC.
444 19TH STREET, BROOKLYN, NEW YORK

TRADE Booth MARK
PRECISION CUT FELT

738

BUILD QUIETNESS INTO YOUR MACHINES



USE G-E CAPACITOR-MOTORS

when you need quiet-running, constant-speed motors, 3/4 hp or under, that have high starting torques. Careful balancing minimizes vibration, and resilient rubber mounting and end-play silencers confine motor vibrations to the motor itself—they are not transmitted to the driven device.

The capacitor-motor will operate for years with little or no attention—it has no brushes or commutator to require periodic servicing, and oiling is necessary but once a year. High power-factor and efficiency make operating costs low, and operating it does not interfere with radio reception. These are some of the reasons why it is rapidly becoming the standard drive for such devices as refrigerators, stokers, and water pumps.

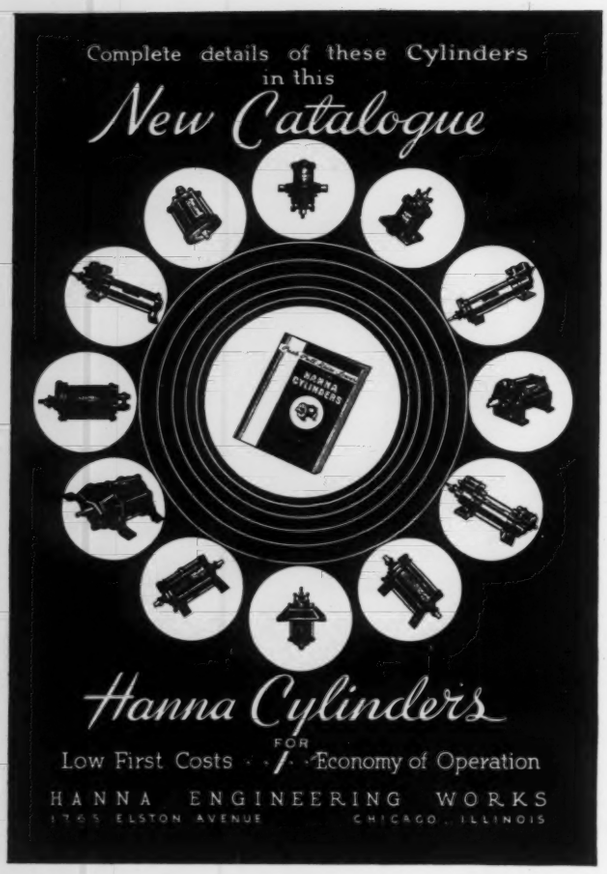
Capacitor-motors are available in many ratings and in various models—totally enclosed, vertical-shaft, flange-mounted, and many others. Separate parts for built-in applications are also obtainable.

In addition, General Electric makes other types of fractional-horsepower motors—it has a motor for every purpose. For further information, write to General Electric Company, Dept. 6B-201, Schenectady, N. Y.

Consider G-E Performance, Convenience, Service.

070-164

GENERAL ELECTRIC



It belongs!
ANY design that embodies parts that must insulate against current, heat, shock, noise or vibration . . . must be strong and tough, yet light and attractive in appearance . . . automatically calls for versatile Vulcanized Fibre. Particularly is this true when these properties are required in combination and when economy, ease of fabrication is a factor.
A full description of the properties of Wilmington Vulcanized Fibre . . . suggestions for its use . . . pertinent hints on its fabrication . . . are part of the content of our complete 32-page treatise on Fibre. A copy of the new edition is reserved for you. There's no obligation.
WILMINGTON FIBRE SPECIALTY COMPANY
MANUFACTURERS OF GENUINE VULCANIZED FIBRE
WILMINGTON, DELAWARE

Business and Sales Briefs . . . . . .

APPOINTMENT of Erwin A. Wendell, formerly sales engineer, to the position of district sales manager of Link-Belt Co., Chicago, with headquarters at 317 North Eleventh street, St. Louis, has recently been made. Mr. Wendell succeeds Howard L. Purdon, who has been transferred to the company's Chicago office to assume sales responsibilities in the Chicago territory.

* * *

Holo-Krome Screw Corp., formerly of Bristol, Conn., is now located at Hartford, Conn.

* * *

Youngstown Sheet & Tube Co., Youngstown, O., has appointed John Edward Daily district manager for the Chicago district.

* * *

Eugene P. Farris has been appointed manager of specialty sales of Emerson Electric Mfg. Co., St. Louis, replacing H. L. Parker Jr., resigned.

* * *

Celluloid Corp., New York, producer of cellulose acetate molding materials, announces the opening of an office to serve the Detroit area, to be located at 512 Stephenson building.

* * *

Louis Keuhn and A. J. Leudke, of the Milcor Steel Co., a subsidiary of the Inland Steel Co., First National Bank building, Chicago, were elected members of the board of directors of the Inland Steel Co., at a recent meeting. Mr. Keuhn has been president of the Milcor Steel Co. since its establishment in 1902.

* * *

According to a recent announcement, an extensive expansion program has been completed by Gits Bros. Mfg. Co., 1900 South Kilborne avenue, Chicago, manufacturers of lubricating devices such as oil and grease cups; constant level bottle oilers for motors, lineshafts and oil reservoirs; automatic multiple oilers, and oil and grease seals for high speed applications.

* * *

L. W. Harston, formerly manager of sales of the mechanical tube division of Steel & Tubes Inc., subsidiary of Republic Steel Corp., Cleveland, has been elected vice president in charge of sales. J. A. Ireland has been made manager of sales for the mechanical tube division and J. J. I. Jamieson has been named district sales manager for the central district.

* * *

Formerly works manager of Piqua Handle & Mfg. Co., Piqua, O., Carroll A. Ross has become associated with his brother, Cleland C. Ross, under the firm name of Ross Engineers, located at 82 St. Paul street, Rochester, N. Y. Ross Engineers are western New York representatives for Bantam Ball Bearing Co., South Bend,

IT'S A **SNAP** TO MAKE WIRE JOINTS WITH **IDEAL** WIRE CONNECTORS!

A—Skin wires as usual

B—Screw connector onto wires

C—Job is finished; time, 15 seconds!

No Tape—No Solder—yet greater conductivity since wire can't pierce through.

Speeds Work—Convenient to use. Just thread on and joint is made. Neater and stronger joints, too.

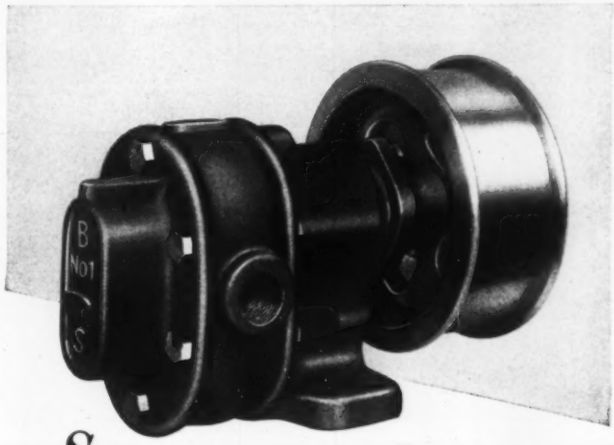
Cuts Costs—in time, labor and soldering material. Speeds up production!

Unaffected by heat, cold or moisture.

Fully Approved—Listed by Underwriters' Laboratories. **Send** for free samples. Millions in use.

IDEAL COMMUTATOR DRESSER CO.

1059 Park Ave. Sycamore, Illinois



Specify 1S - 2S - 3S

for—Quietness—Long Life

. . . and besides, these modern rotary geared pumps can be run at High Speeds.

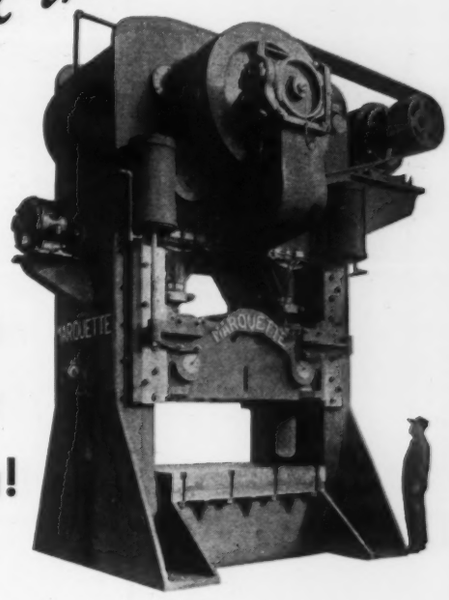
Important features are: helical gears—renewable bearings—well balanced design.

Write—Brown & Sharpe Mfg. Co.
Providence, R. I.

BROWN & SHARPE PUMPS

B·S

Go all the way



When You Design for Lubrication!

1 Select the proper material for the bearing conditions;

2 Provide sufficient area to support the load;

3 Design grooving correctly to insure proper distribution of lubricant;

4 Protect with adequate seals where necessary—*and also*

5 Provide the best method for supplying the bearings with the proper amount of lubricant at all times!

Unless a positive, dependable source of lubricant supply is available, the most careful consideration to materials, design, grooving, etc., will not prevent premature wear or even failure.

When you design for lubrication, *go all the way—include Farval!*

The Farval System is a mechanical method of delivering clean lubricant from a central station, under high pressure, to a group of bearings, in exact measured quantities, and at regular intervals. Its operation may be either manual or fully automatic.

By the Farval Method, frequency can be varied to suit conditions, but the performance is always constant and positive. No bearings can be missed; none can receive too much.

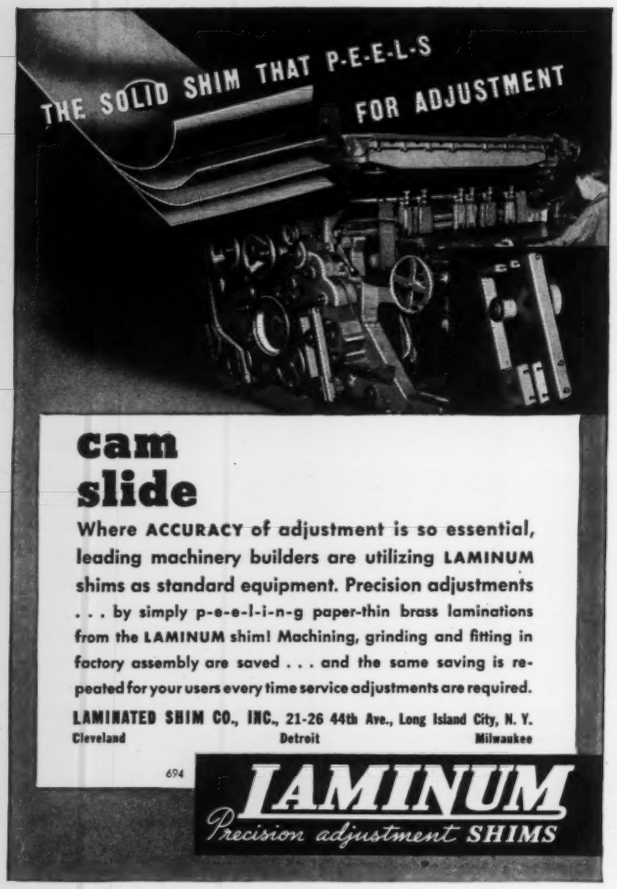
Design Engineers are invited to write for complete information and technical data. The Farval Corporation, 3265 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL

CENTRALIZED SYSTEM OF LUBRICATION

Special Delivery to Every Bearing


THE SOLID SHIM THAT P-E-E-L-S FOR ADJUSTMENT
cam slide
Where ACCURACY of adjustment is so essential, leading machinery builders are utilizing LAMINUM shims as standard equipment. Precision adjustments . . . by simply p-e-e-l-i-n-g paper-thin brass laminations from the LAMINUM shim! Machining, grinding and fitting in factory assembly are saved . . . and the same saving is repeated for your users every time service adjustments are required.
LAMINATED SHIM CO., INC., 21-26 44th Ave., Long Island City, N. Y.
Cleveland Detroit Milwaukee
694
LAMINUM
Precision adjustment SHIMS

INDEX for 1936

The index for 1936 issues is ready for distribution. In addition to the usual contents index, a combined itemized index, which considerably simplifies the finding of material on a specific subject, is included.

There is no charge for the index. However, it will be sent only to those readers who previously have requested a copy of each index as published, and to those writing in for this particular copy. MACHINE DESIGN, Penton Building, Cleveland.

Ind.; Hilliard Corp., Elmira, N. Y.; Lovejoy Tool Works, Chicago; Master Electric Co., Dayton, O.; Torrington Co., Torrington, Conn.; and Tuthill Pump Co., Chicago. Carroll A. Ross will have charge of the Buffalo district, with headquarters at 252 Crescent avenue, Buffalo.

* * *

T. D. Montgomery has been appointed manager of the sales division of Cutler-Hammer Inc., Milwaukee.

* * *

Lincoln Electric Co., Cleveland, has announced the appointment of W. R. Smith to the sales staff of its Los Angeles office, 812 Mateo street. The Los Angeles office is in charge of G. S. Parsons.

* * *

A new addition to the plant of the Foote Bros. Gear & Machine Corp., 5301 South Western boulevard, Chicago, has been completed which adds 5300 square feet of floor space to the assembling and testing departments.

* * *

William E. Fischer has been added to the sales staff of the San Francisco office with headquarters at 866 Folsom street, for Lincoln Electric Co., Cleveland. Robert Daniels has been placed in charge of this company's Chattanooga office, located at 1015 Hanover street.

* * *

W. C. Treadwell, an expert on finishes, with long experience in electroplating and metal finishing, will cover all New England for Maas & Waldstein Co., Graybar building, New York. Mr. Treadwell's headquarters is at 22 Vine street, Melrose, Mass. John Dahlquist, 411 Forest avenue, New York, will represent Maas & Waldstein Co. in western New York and northeastern Pennsylvania.

* * *

Carl A. Gray, formerly vice president of Capewell Mfg. Co., has been elected vice president and director, Whitney Chain & Mfg. Co., Hartford, Conn. Other officers are: Charles E. Wertman, president; Winthrop H. Whitney, vice president and treasurer; A. S. Basten, vice president; and Park C. Boyd, secretary and assistant treasurer.

* * *

Promotions recently announced by Youngstown Pressed Steel Co., Youngstown, O., are as follows: Thornton E. Stokes, manager of sales of the marketing division; Frank W. Knecht Jr., assistant to Mr. Stokes; Howard C. Wolf, assistant manager of sales of washing machine parts; and A. G. Knowles, manager of sales of the material handling division.

* * *

Opening of new branch sales offices and warehouse facilities by Bunting Brass & Bronze Co., Toledo, O., at 296 Ivy street, Northeast, Atlanta, has recently been announced. The company is moving from the combination Atlanta warehouse, from which it previously served the trade, into the new establishment at the above address.

* * *

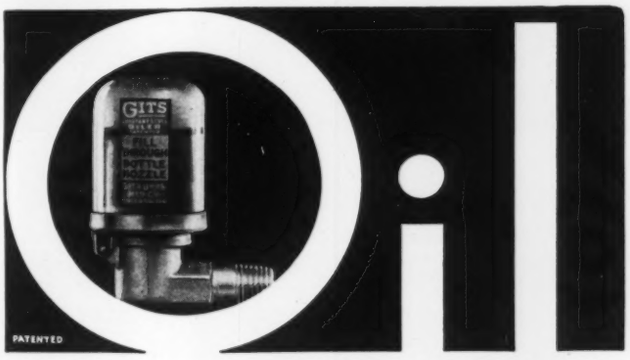
Ajax Flexible Coupling Co., Westfield, N. Y., manufacturers of light, medium, heavy duty and special types of flexible couplings for direct connected machinery, has announced the completion of its new factory addition which provides increased manufacturing facilities. The

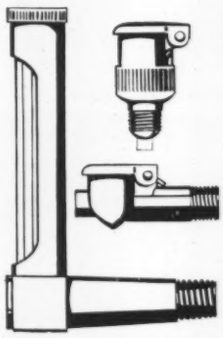
SIMPLE AS A·B·C·

It is the simplest engineering axiom that . . the fewer the parts the less the friction and wear . . the longer the life. The Viking Rotary Pump has "Just Two Moving Parts" . . the simplest possible design for a pump. Little wonder they require so little power . . need so few repairs . . and last so long. Little wonder, too . . why designing engineers have selected Viking Hydraulic and Coolant Pumps for such a wide variety of machine tool applications. Write for Special Hydraulic and Coolant Pump Bulletins.

VIKING PUMP CO.
CEDAR FALLS, IA.

OIL CUPS





Seven hundred styles and sizes — to fill any industrial requirement — is proof of Gits leadership. The Gits line includes a complete range from regulation oil hole covers to special feature oilers — unbreakable sight wick feed, gravity feed or constant level oilers — oil cans — oil and grease seals and gauges. General catalog includes illustrations and complete information on all styles.

GITS BROS MANUFACTURING CO.
1861 S. KILBOURN AVE., CHICAGO

BEFORE THE CIVIL WAR

IXL GEARS TURNED THE WHEELS OF INDUSTRY

The Mechanical Advantages of the North Were An Important Factor in its Favor

Gearing problems were simple before Fort Sumter was fired on. As the Machine Age advanced, they were best solved by gear engineering specialists. IXL engineers from that time and for three quarters of a century, have been designing and building gears, powered gears and speed reducing units. IXL equipment in any service symbolizes *the best.*

Veteran IXL gear engineers in the best equipped factory in the world producing gearing exclusively, with over 100,000 hobs, cutters and patterns available, have maintained the highest standards for 76 years. The IXL plant is truly industry's gear headquarters.

Be your requirements any type of gears in pounds or tons, regardless of industry or location, look to IXL for engineering design, unequalled production and trouble-free performance.

FOOTE BROS.
GEAR & MACHINE CORPORATION
5303 S. Western Boulevard - Chicago

IXL
The Mark of Quality

A complete line

Speed Reducers
Worm
Helical
Herringbone

Combinations
Gears of All Kinds
Metallic
Non-Metallic

Powered Gears
Helical Type
Radiating Worm
Gear Type

Stoker Drives • Friction Clutches • Couplings